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CONTENTS

OF THE

SECOND VOLUME, SECOND SERIES.

Specifications of Patents published in this Volume.

Observations

M. ROBERT,

Method

PLATES

IN THE

SECOND VOLUME, SECOND SERIES.

Besides numerous Wood-engravings.

THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

NUMBER VII. SECOND SERIES. DEC. 1, 1802.

Specification of the Patent granted to THOMAS MARTIN, *of Goswell-street, Clerkenwell, in the County of Middlesex, Saddler, Collar, Harness-maker, and Tawer; for Improvements in the Art of Tanning and Dressing Hides and Skins.* Dated April 19, 1802.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said Thomas Martin do hereby declare my invention to be described in manner following; that is to say: My invention consists in placing a boiler, of convenient size, as near a reservoir of water as the nature of circumstances will admit, with a pipe near the edge of the boiler, to convey the warm water into a tub or vat, which should be placed near to, and rather higher than, the vats in which it is intended to place the raw goods, and those working out of the limes; so that the first may empty itself into a second and third vat, or into as many

as may be deemed necessary. These vats must have false bottoms, for the reception of the sand and filth. But a pipe, with a cock between the vats, is preferable to the method of flowing. The first tube or vat is not intended for goods, but only to regulate the warmth of the water.

The blood and filth congealed in the pores of the pelt, when the animal was dying, together with the dirt collected in the slaughter-house, markets, &c. &c. will, by the application of the water, rather warmer than blood heat, be more readily separated from the skins, and will sink under the false bottoms, whence it may be conveyed into a sewer by pulling out a plug from the real bottoms. The application of warm water will revive dried hides, and will greatly expedite the process of tanning or dressing by expanding the pores for the reception of the ooze, alum-liquor, &c. The hair, and particularly wool, in this manner will be more easily cleansed of the dirt. The raw hides may, however, be immersed in cold water to cleanse them from the external blood and filth previous to their being put into the warm water. By this method the hides or skins will not require so much drenching (if any) in sours, as in the mode commonly used. The hides being perfectly cleansed from blood and extraneous matter in the usual manner, with a knife, on a beam, are ready for the limes: when they are sufficiently limed, and the hair taken off, they should be worked out clean from the lime with warm water: any remaining blood or lime in the pores prevents the ooze or other materials for tanning, tawing, currying, or dressing, of leather, from penetrating into the fibres, and renders the leather hard when tanned, or otherwise dressed.

Having described my method of preparing the goods for the ooze, and the subsequent processes, I shall now proceed

proceed to the vats. I construct a circulation plant, of sixteen pits or vats, each of about six feet long, four feet and a half wide, and six feet deep, but the principle will equally apply to any number and of any dimensions. The pits must be constructed of sound wood; the upper planks of oak; the ground on which the vats are to rest should be level and clear of all stones, to prevent any irregular bearing. I then place pieces of wood, resembling flooring-joints, at equal distances, at least one under each side and partition, one under the middle of each pit, and one under each end. On the joints I fix a well-jointed sound bottom, with grooves, into which I fit the sides, extremities, and partitions; the sides and extremities two inches higher than the partitions. The sides, ends, and three side partitions, should be of planks that extend throughout, or be carefully jointed: twelve end-partitions will divide the whole into sixteen pits.

The vats may be on the surface or the edge, eighteen inches above the level of the yard. As the sides and ends are liable to bulge from the weight of ooze, fix several metal cramps at the bottoms, ends, and sides; also cut a groove at the ends of the end-partitions, and fix a metal bar, of sufficient size, across the ends of each. Make loose false bottoms, with crevices or holes not less than six inches from the real bottoms. By taking up the false bottoms, the filth that accumulates in the vacancy may be removed. At least, two inches above the false bottoms must be circulation-holes, at transverse corners, large enough to permit the liquor to run from one vat to another: fix ledges, mitred and hollow, two-thirds of their length, on the side the ooze runs from; and others on the opposite side, hollowed one-third of their length. Guard-boards should be placed on the side the ooze runs from, with holes or crevices from the top to the false

bottoms; likewise on the opposite side, with as many holes as the former, but contained in the lower half of the guard-boards: these boards, being placed at transverse corners, will prevent the hides from lying flat against the circulation-holes, or the bark, &c. from clogging them up. Fix slips, or rabbets of wood, at each side of the circulation-holes, with valves or sliding doors to move up or down, by means of a strong wire, or bungs or plugs to put in or take out.

For the convenience of going from one vat to another, it will be necessary to lay planks on the ends of the vats; these planks should be eighteen inches broad, three inches thick at one end, and reduced gradually to two inches at the other end, and rather hollowed in the middle: at the thinnest end, over the joint between the side of the vats and the ends of the plank, must be nailed a piece of leather, or other substance, to prevent the rain-water from falling into the vats from the covers. On the under side of the planks fix ledges to fit the partition, and brackets nailed on the sides of the vats; at the ends of the planks will be a steady support for them without being fixed.

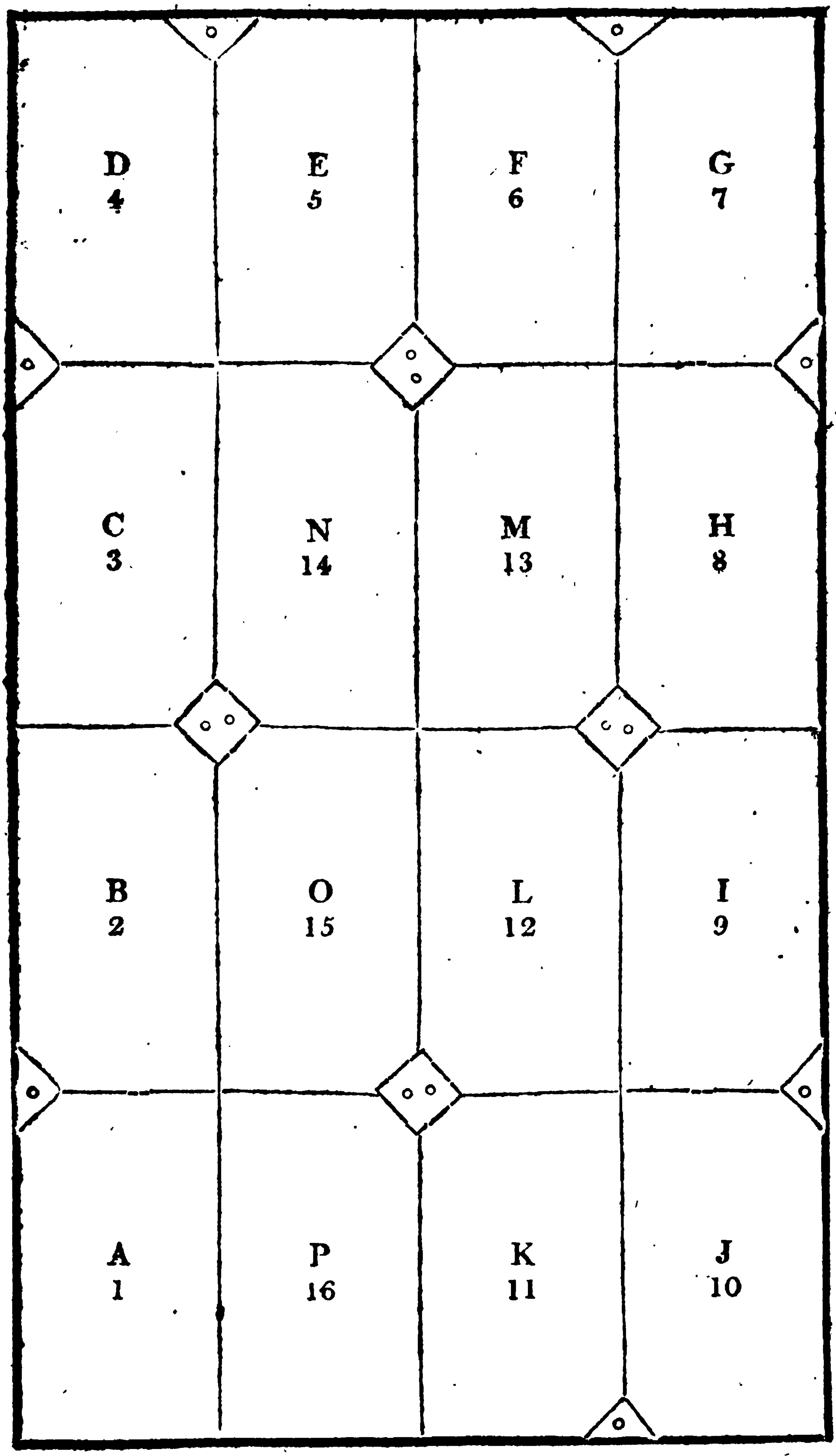
It will be essentially requisite to remove, and frequently (by this process) to handle the goods, in one or other of the vats, without being interrupted by the circulation of the ooze; at the same time the circulation of the ooze need not be impeded. In the annexed representation, suppose L is to be emptied, and the ooze to continue its circulation from K to M; the valves or sliding doors in K and M on the side next to L must be pushed down or pulled up. Provide a loose pipe, of sufficient bore, eight feet long, with returned ends. Lay this pipe with the ends upwards; stop one end with a bung or plug, fill the pipe at the other end with ooze,

stopping

stopping that also; then turn the pipe with the returned ends downwards, both being below the surface of the ooze, one end in K (the pipe lying across L), and the other in M; pull out the bungs, (by means of thongs for that purpose,) the pipe will convey the ooze from K to M; in the mean time the goods in L may be handled, removed, and the vats emptied or cleaned.

By means of a pump or jet you may remove the ooze out of P into A, which, with B and C, or as many as are deemed necessary to contain bark, shavings, or chips, are commonly called spenders: the ooze will be refreshed each time of circulation from the acid retained in passing through the goods, will run clear above the false bottoms, leaving the filth undisturbed under them.

Another method I adopt, is to elevate a large vat three feet above the surface of the ooze. Let the ooze be pumped from P into the elevated vat, which may be made a receptacle for placing goods, bark, &c. and will answer the purpose nearly as well as any of the vats. Suppose the fire for heating the boiler before mentioned to be twelve yards from the elevated vat, a second boiler, with a cock near the bottom, may be placed at the same fire, with a lid, to prevent the soot from falling into it, which would stain the leather: the elevated vat must have a pipe with a cock in it, extended through the bottom, (with osier or wire-work, or guard-board, with holes, to prevent bark or filth from going down,) which will convey the cold ooze into the second boiler, and will likewise cause the warm ooze (the boiler becoming filled) to run down a pipe of larger bore placed near the edge of said boiler, leading into vat A. This method may be adopted for warming alum-liquor, or other materials for dressing leather.



It

It is preferable to have the whole of the vats under cover of a roof, or a shed. They may likewise be covered singly by placing boards, 18 inches broad, edgewise, at the ends of the pits, on the planks, with brackets to support them, and notches at the ends to fit to each other. At the end of these must be placed boards, 18 inches broad, gradually terminating in a point at the end of the pit, provided with metal hooks to fit into eyes in the boards with brackets, and likewise stumps to fit into holes at the edges of the pits, to keep them steady. Near the upper edges of the side boards must be cut grooves, into which must be fitted boards across the pit, with edges to lay over each other, so as to carry off the rain-water into the hollow planks. By placing mats of straw or flags on the covers, the frost will be effectually prevented from injuring the goods.

There being several plants of pits in a yard on this construction, the oozes may be made of different degrees of strength of the tanning principle at the tanner's pleasure: one of which plants of vats may be used for the bark after the greatest part of its virtue has been exhausted. By placing chalk under the false bottoms it will assist in taking away the acid retained when in conjunction with the goods. There being no hides or skins in this plant, the ooze may be made warmer, which will draw the remaining virtue from the bark, and make a good soft ooze, fit to be placed with goods, and make a considerable saving of that article.

The necessary pumps may be wrought by men, or by the bark-mill, commonly turned by horses, or by a third boiler, at the same fire, the steam of which may be employed by means of an engine to grind the bark and work the pumps. The fire for the before mentioned purposes will prove of utility in drying the new bark, and making

it

it grind well, and likewise in drying the old, exhausted bark for burning, also for drying the leather, hair, wool, glue-pieces, &c. &c.

By turning the cock in the pipe leading from the elevated vat, the warmth of the ooze may be regulated to little warmer than the heat of the animal when alive; by which the tanners and dressers of leather are enabled to work in the most severe and intense frost; the pores having been opened for the extraction of the blood, &c. and those whence the hair grew: by this circulation, leaving the filth under the false bottoms, the clear, warm ooze, &c. having penetrated the fibres, they will admit materials for currying and bringing the leather to that state of perfection requisite for manufacturing for different purposes in a few days, and be of longer durability, more tough and elastic, of greater strength, and far less expensive, than by the former methods.

Let a vat or well (being made sound) be sunk at some distance from the vats with a pipe in it from P. This well being deep, and large enough to contain the ooze of any one of the vats below the bottom, any vat requiring to be emptied, it may be effected by placing the end of a pipe to the bottom of the vat, (the necessary circulation-holes being shut,) the other end of the pipe being in the well, but lower than the bottom of the vat, the ooze will pass into the well. The same well, pump, and boiler, will serve for several plants of vats by opening or shutting the valves against the circulation-holes in the vats leading to the well. This done, the whole of the ooze may be pumped into the elevated vat, whence it will run down into the boiler. A pipe, with a screw, may be fixed, or a trough placed, to the cock near the bottom of the boiler, to convey the ooze into the vat: thus you may remove the ooze from one set of vats to another

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Pl. II. second series.

Fig. 1

another with very little trouble by only altering the valve against the pipes leading to the well, and turning the cocks in the pipes leading from the boiler to the different plants of pits. Old vats in the common method, at a distance from each other, will require pipes from one to another to make circulation-holes.

N. B. The hides of horses, and other animals that die of themselves, the congealed blood, filth, and dirt, is seldom totally extracted, which prevents the ooze and other materials for dressing and currying from penetrating into the fibres. These hides, when tanned or dressed, are easily known, and are denominated casualty ones. By the adoption of my method of preparing the skins, the blood, &c. may be easily and more completely extracted; and these hides, when manufactured, will be nearly equal to slaughtered hides or skins.

N. B. From some experiments I have made for months past, I find as good leather may be made by my method of tanning from shavings, saw-dust, and chips, containing the tanning principle, particularly oak, as from bark.

In witness whereof, &c.

Specification of the Patent granted to CHARLES WYATT, *of New Bridge-street, in the City of London, Merchant and Manufacturer; for his Invention of certain Improvements in the Apparatus for, and Mode of distilling, drying Coffee and Sugar.* Dated August 2, 1802.

With a Plate.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Charles Wyatt do hereby declare that the

the nature of my said invention is described in manner following; that is to say: My improvements in distilling consist of two parts; first, in applying steam to produce the heat required for distillation, and adapting an apparatus for that specific purpose; and, secondly, in varying the construction and disposition of common stills when fire alone is to be employed.

The process for distilling by steam is this. Steam is to be produced from water or other liquid contained in a closed boiler, and conveyed through proper tubes or channels either into the matter intended for distillation, or through it, or wholly or partially round or beneath, and in contact with the external surface of the still or vessel in which that matter is contained, or in any of those methods combined; that of introducing the steam wholly and totally into the body of the liquid to be distilled, so as to be mingled therewith, being the most effectual and advantageous.

The liquid being thus heated by the action or contact of steam, the subsequent parts of the process proceed in the same way, or nearly in the same way, as in common distillation over a fire.

Figs. 1, 2, 3, (Plate I.) represent different views of one mode of constructing an apparatus for this purpose. Figs. 4 and 5 views of another mode; and Fig. 6 of a third mode; the uses of each part being explained in the references.

The parts essential to the system of distilling by steam may be omitted in Figs. 1, 2, 3, 4, 5, and then the apparatus will be applicable to the common mode of distilling by fire alone, which constitutes the variation stated to be the second part of the improvement on the mode of distilling; this part of the invention consisting in making the roof of the still a medium of condensation, and ap-

plying

plying a channel beneath that roof to conduct the liquid arising from that condensation into the ultimate condenser.

When steam is used, the vessels or stills may be made of metal, wood, brick, stone, slate, or of any other substance or substances capable, or made capable, of containing the liquid to be distilled, and of resisting the action of steam.

The mode of drying coffee and sugar consists in exposing those substances to the action of air, raised to the necessary degree of heat, by passing over or in contact with a body or bodies heated by steam.

If therefore any space or receptacle, admitting and discharging occasionally the external air, be allotted for drying coffee or sugar, and that space or receptacle be heated by the access of steam, so that none of the steam shall come into contact with either of those substances, that construction of an apparatus will produce the effect that I mean to describe as my invention. Figs. 7, 8, 9, shew what I consider to be the most convenient and expeditious mode of effecting this purpose. This apparatus may be applied to the drying of other substances, such as grain, gunpowder, &c. &c.

In witness whereof, &c.

References to Plate I.

Fig. 1, longitudinal section of the boiler, stills, and refrigeratory.

Fig. 2, plan of the boiler and stills.

Fig. 3, transverse section of the stills No. 1 and 2, and refrigeratory.

Fig. 4, section of two round stills, one placed upon the other.

Fig. 5, plan of the round stills.

A, boiler for water. B, fire. C, flue. D, wash-stills. E, low wine still, or in Fig. 4 low wine still, or a preparatory wash still, or a refrigeratory. F, rectifying still. G, refrigeratory. H, cistern for supplying A. *i*, main steam pipe. *k*, branches, one to each still. *l*, a shelf or gutter to collect and convey to the ultimate condenser what is produced from internal condensation. *m*, spaces in the shelf. *n*, roofs extending over the spaces. *o*, man-holes. *p*, charging pipes. *q*, passage to the ultimate condenser. *r*, locks to regulate the admission of steam.

Fig. 6, A, water heated by fire. B, C, subjects to be distilled.

Fig. 7, longitudinal section of the coffee-heater.

Fig. 8, transverse section.

Fig. 9, plan.

a, box, trunk, or chamber. *b*, *c*, entrance and exit for steam. *d*, cavities for steam, constructed of metal, quite steam-tight. *e*, aperture for the admission of air, and discharge of the cylinders. *f*, aperture for the escape of air. *g*, cylinder to receive the substance to be dried. *h*, space for warm air. *i*, regulator of air admitted.

Operation.

Steam from a closed-boiler being introduced through *b*, fills the cavities, and passes off through *c*, and in its passage warms the air contained in *h*, supplied through *e*, and discharged through *f*; by the revolution of the cylinder placed in the current of air thus warmed, the substances within it are dried.

Specification

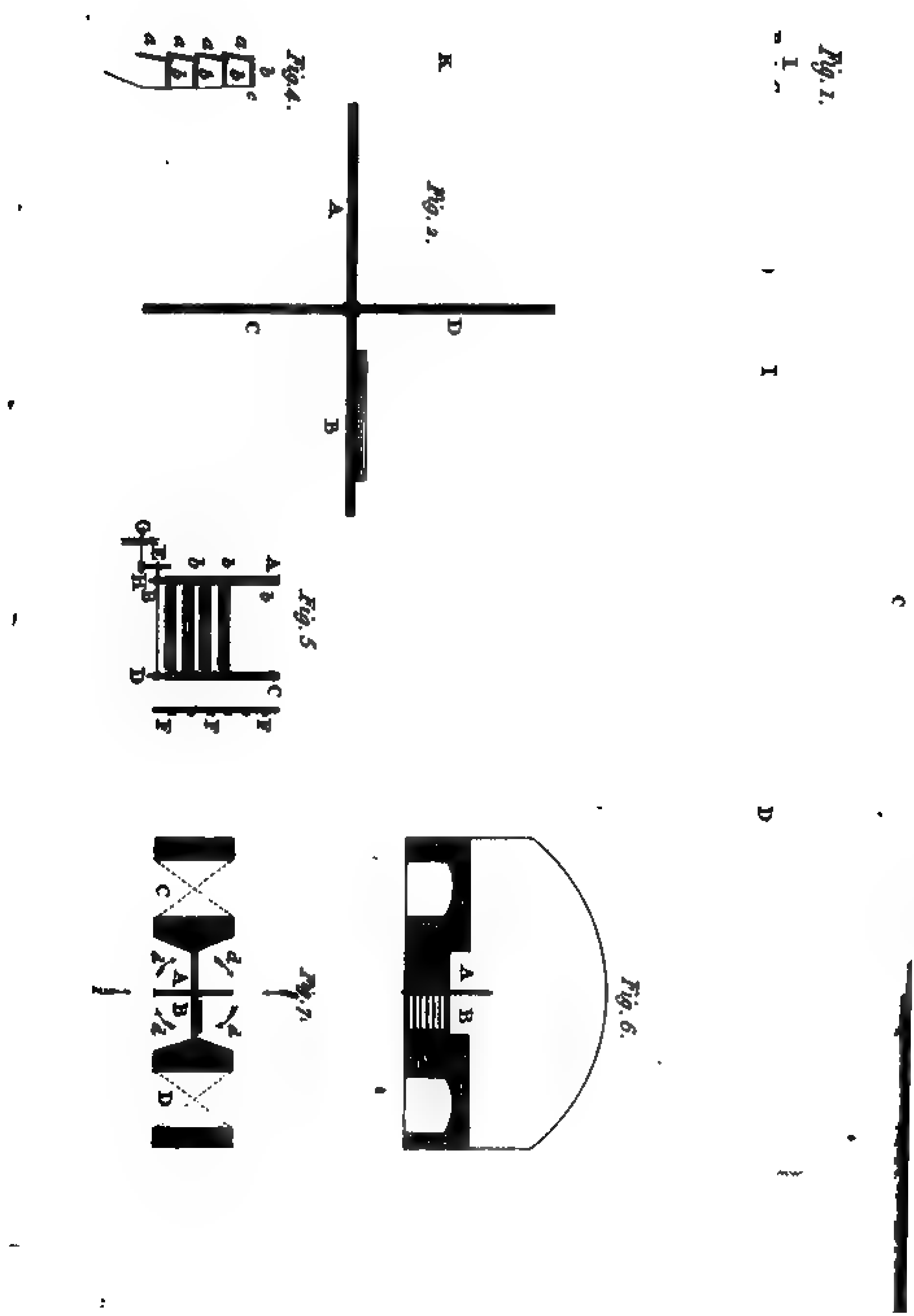


Fig. 1.
Fig. 2.
Fig. 4.
Fig. 5
Fig. 6.
Fig. 7.

Specification of the Patent granted to ROBERT BEATSON, *of Kilrie, in the County of Fife, North Britain, Esquire, late of His Majesty's Corps of Royal Engineers; for his improved Method of applying the Power of Wind and Water to horizontal Mills, and the same Principle to other Purposes.* Dated October 31, 1797.

With a Plate.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Robert Beatson do hereby declare that my said invention of an improved method of applying the power of wind and water to horizontal mills, and the same principle to other purposes, principally depends on a peculiar method of constructing and disposing those surfaces upon which wind, water, air, or any other fluid shall act; by which means, and by opposing alternately a resisting and a non-resisting surface, their whole force or impulse acts in a direct manner upon the resisting side of a wheel, vane, sail, or other surface, in proportion to its extent; and when the non-resisting side is returning against, or opposed to, either of these powers, there is very little resistance, however large the original opposing surface may be. And *vice versa*, when such surface, constructed upon these principles, is required to act against any fluid, the resistance will be considerable on the one side, and very small on the other. When applied to horizontal windmills, the power of those mills, even with the same quantity of sail or acting surface, may be increased or diminished as shall be required; and upon this principle windmills may be constructed in any form of building, or in the same form of buildings as at present, and the same principle may be applied to several other

other useful purposes; all which will appear more clearly by the following explanation and description of the annexed drawings (Plate II).

FIRST, *with respect to Windmills.*

Fig. 1. is a direct view or elevation of two opposite sides of an horizontal windmill, wherein A B and C D are two of the upper arms, and E F and G H two of the lower arms, of which there are four in number, crossing each other, that is to say, four upper arms and four lower arms; but there may be more if thought necessary, and, for some purposes, perhaps even fewer may do, although it is presumed four will be sufficient for any purpose. I K is the vertical shaft into which the arms are fixed. L M N O and P Q R S are two frames, which may either be immoveably fixed between the upper and lower arms, or they may be made to slide backwards or forwards so as to be placed nearer to, or farther from, the vertical shaft, as shall be required. The surface or space contained within these frames (which I call the vanes) is filled up, or covered, with any sort of thin light substance or material for the wind to act upon, as canvas, linen, silk, leather, skin, or even paper or pasteboard, which, if thought requisite, may be prepared either with oil, tar, paint, varnish, or otherwise, in such a manner as to resist wet, and to enable the wind to act upon them with the more effect. Or these spaces or vanes may be covered with very thin wood or boards, or thin plate iron, tin, or copper, or in short with any other thin or light substance or substances suitable to the purpose.

It will, however, be observed, that with whatever material or materials these vanes are covered, it must not be in one whole piece, but divided into a number of small separate parts or flaps, placed or suspended in such

a manner

a manner as to over-lap each other a little. That is to say, if the mill is intended to turn round from left to right, the lower part of the upper flap 1 of the vane L M N O must over-lap the upper part of the flap 2. The lower part of 2 must over-lap the upper part of 3, &c. so that, all the over-laps being on the near side, the flaps will all be close shut when the wind acts upon them, and consequently the vane will receive its whole impulse the same as if it consisted of one entire piece. The flaps in the opposite vane P Q R S must however be suspended in a different manner. That is, the over-laps must all be on the reverse or off side, by which means, while the wind shuts all the flaps on the left or resisting side L M N O, and is acting thereupon with its full force, it opens all those on the right or non-resisting side P Q R S, and passes through between them with little or no resistance except what is occasioned by their thin edges, which should be as thin as possible, that the resistance may be the less; and if these flaps are properly suspended and counterpoised, the resistance will be nearly as small as if there was no covering at all upon the vane P Q R S.

It is therefore evident, that if there are four of these perforated vanes, crossing each other as in the plan Fig. 2, when the wind acts upon the resisting side A with all the flaps shut, and passes through the non-resisting side B with all the flaps open, as shewn in the figure, A will be impelled forward, and will be succeeded by C, upon which the wind will then begin to act; and thus, by the one vane succeeding the other, a constant rotation will be produced so long as there is wind sufficient to impel them forward: and it matters not from what quarter the wind blows, as its effect will be the same upon vanes of this construction, which will always turn the same way with any wind. If the over-laps were made on the near

side

side of the right vane, and the off side of the left, they would turn round the opposite way, as the right side would in that case become the resisting side, and the left the non-resisting.

The flaps of the vanes should consist of thin light frames of wood, metal, whalebone, or any other substance fit for the purpose of stretching the canvas, linen, silk, &c. upon, and should be suspended by two small bolts, staples, or hinges, at the upper corners, upon which they should hang freely and loosely, so as to be easily opened by the wind; but, if they are made of thin wood, or light plates of metal, there will be no occasion for stretching-frames, as the bolts or hinges may be fixed to their upper corners. Instead of over-lapping, these flaps might be made to shut close to each other, with a stop or catch at the lower corners, to prevent them blowing through; but it is better to make them over-lap for several reasons, particularly as they will resist the wind better, and the one will support the other in a firmer and stronger manner. When mills on this principle are made on a large scale, that is, when the vanes exceed five or six feet square, or thereabouts, it would be proper to divide those spaces in two or more parts or pannels vertically, as shewn in Fig. 3, by which means the flaps will have the shorter bearing, and may therefore be made the thinner and lighter; and, by dividing them vertically in this manner, they may be so contrived, that all the flaps, in any of the vertical spaces or pannels, may be kept open or shut at pleasure, to give the mill more or less vane, according to the force of the wind. In large mills too, it will be necessary to support the lower arms by means of struts or braces A, A. There might also be on the top of the shaft a pole or rod B C, from which ropes C D and D E might extend to the extremity of the arms.

There

There might also be ropes horizontally fixed to the ends of the arms, so as to connect them together; all which ropes and braces will tend very much to strengthen and support the arms. Small uprights, of iron or deal, might be used instead of ropes, to connect the ends of the upper to those of the lower arms. The vanes, as has already been observed, may either be fixed in one position, between the upper and lower arms, or they may be made to slide farther from, or nearer to, the vertical shaft, according to the power that may be required; for it is evident, the farther they are placed from the shaft, or centre of motion, the greater power and effect will the wind have upon them.

The manner of stopping and regulating this mill may either be by a brake or gripe, as in the common wind-mills, or (what is perhaps better) by a contrivance for opening or shutting all the flaps of the vanes at pleasure. This may be done by small ropes or chains, fixed to about the middle of the lower edges of the flaps, and conducted over rollers or pulleys at the top of the vanes to the inner side of the mill; by means of which ropes or chains all the flaps in the vanes may be at once drawn up when required. A preferable method perhaps is shewn in Fig. 4; being a section of four of the flaps *a*, *a*, *a*, *a*, representing the manner they over-lap each other. *b*, *b*, *b*, *b*, are thin pieces of iron, edge upwards, fixed to the flaps, or to the gudgeon, and projecting about as many inches as the flaps are broad. To the outward ends of these projecting irons (which may be called *lifters*) a small rope or chain *c d* is fastened, so as to connect with all of them; consequently, when that rope or chain is drawn downwards, (which it may be by different contrivances,) it will open all the flaps, either partly or entirely, and so regulate the mill, or stop it altogether,

altogether, when necessary. Other methods for opening the flaps of the vanes, or of each pannel separately, might be mentioned; such as that shewn in Fig. 5. A B and C D are two thin bars of iron, pierced, with long apertures, as at *b b b*, &c. These bars are made to slide easily up and down upon the face of the frame, by which the gudgeons of the flaps are supported. These gudgeons may have a small trigger or projection, which is put through the long apertures, when the bar is in its place; so that, if these bars are moved upwards, the lower parts of the apertures pressing upon the triggers open all the flaps, if they are suspended on the resisting side of the vane; and if they are moved downwards they may be made to keep them all shut. If they are suspended on the non-resisting side, (which is the best way,) the downward motion of the bars will open the flaps; the upward motion shut them. These bars may easily be moved upwards or downwards, by small racks and pinions, as at B and D, turned by means of a sheave or wheel at one end, as at E, having a small rope over it, to communicate with the inside of the mill; or by another pinion and small wheel or sheave, as at G and H. Instead of apertures in the bars, the same effect might be produced by small rods, with projections, as at F, F, F, or by notches. But these mills might be easily made to regulate themselves, according to the power of the wind, by means of bulk, weights, or pendulums, fixed to inflexible rods, and suspended without the mill upon the arms or frames, or within it, in such a manner as to operate upon the sheaves or pinions, or the ropes that open the flaps; which, if these balls or weights are properly situated and constructed, they will do more or less, according to the velocity at which the vanes are moving.

Several

Several other ways might be mentioned of applying the same principle here explained to horizontal windmills, particularly by making the flaps of the vanes stand vertically or obliquely, or by making them or the vanes of different other shapes; or, instead of frames for the vanes, the flaps might be suspended on uprights, fixed between the upper and lower arms, and the vanes might be made of a concave form, on the resisting side, and convex or angular, on the non-resisting.

They might also be constructed with only one set of arms, to which the perforated vanes might be fixed; but whatever may be the manner of applying it, the principle I claim the invention of, is as before described and explained, being the manner of opposing alternately a resisting and a non-resisting surface, by dividing it into several small spaces, which are so contrived and placed as to shut and oppose their whole extent collectively to the wind; when acting on one side, and when on the other, they all give way, and allow it to pass through with little or no resistance, except what is occasioned by the thin edges of the flaps, together with the small proportion of resistance made by the power requisite for opening them, or raising them up; but this resistance may be reduced to almost nothing by poising the flaps in such a manner (by weights upon the lifters, or otherwise) as to rise very nearly of themselves, or at least to require only the smallest possible power or motion of the wind to raise them.

SECONDLY, *with respect to Water-Mills.*

The same principle, already explained, may also be applied to horizontal water-mills, in proper situations, especially for wheels to go under water in the current of a river, or by the ebbing and flowing of the tide, where

the situation will not admit of any fall for under-shot or over-shot wheels, or when the river is apt sometimes to rise, and sometimes to fall, so much that such wheels cannot be used advantageously.

At the same time, where mills of some sort would be of great utility in raising water to supply towns, country seats, &c. or for other purposes, a wheel, on the principle here mentioned, might be used in such places to great advantage, as it would go either wholly under water, or partly so, and would always turn round the same way, whether the current was running down the river or up, as when affected by the tides, and therefore might be applied to tide-mills. This will be more apparent by referring to Figs. 6 and 7. A B is the horizontal water-wheel, placed in the current of a river or of the tide, either under the arch of a bridge, or in any other suitable place; at which it may be contracted by two walls, C and D, or by any other means, in order to render the current the stronger at the wheel. A is the side with the flaps shut, or the resisting side, where the current runs in the direction of the dait 1, B is the open or non-resisting side, advancing against the current. When it runs in the direction of the dait 2, B will be shut, and become the resisting side, and A will be open, and be the non-resisting side; consequently it is evident, that whichever way the current runs, the wheel will turn round in the direction of the four crooked darts *d, d, d, d*; and, if the over-laps were made on the side B, the wheel would always turn the reverse way.

The flaps for water-wheels of this sort may be made either of thin deal or other boards, or of thin plates of iron, copper, or other metal. These water-wheels may be stopped or regulated by a sluice, on either side, to stop the current, or to admit only so much as is thought necessary;

necessary; and there may also be sluices at C and D, to open when the wheel-sluices are shut.

It is thought unnecessary to give drawings of any part of the machinery connected with these wind and water-mills, that being no part of the invention; for they may be applied to any sort of machinery whatever. And vertical wind-mills might easily be altered to this horizontal form, which saves a great deal of machinery at the top of the mill, and requires no attendance to turn it to the wind.

THIRDLY, *with respect to other Purposes.*

The same principle may be applied to several other purposes, as follows:

1st. It may be applied to the pistons of pumps, on a large scale, which, if divided into a number of long narrow valves or flaps, will be much better for such pumps than if all in one valve. The pumps may in this case be made square, and of any dimensions; and, having a lever or handle in proportion, may, with a small power, raise an immense quantity of water in a short time. Such pumps may either be worked by hand, by the horizontal mill, or by any other power, and might be of particular service on board of ship in case of a leak; for which purpose, portable or moveable pumps, of a great width, might be kept on board of all ships, to be ready to put down the hatchways, or any other part, when necessary to throw out the water, which would be done more expeditiously in this manner than by boiling or otherwise. And even on board of ship the horizontal windmill might be used to work such pumps, which would be a very great relief to the seamen in many cases.

2d. To accelerate the motion of ships, vessels, or boats, by means of a flat surface, divided into a number

of

of spaces or flaps, which, when drawn or pushed the on-way, will act with its whole force against the water, and when the other, will give way, and easily be brought back, so as to re-act in the same manner. This may be done either by pushers, with long poles, or handles over the stern, or any other place, or by being suspended over the sides, and drawn backwards and forwards in various ways.

3d. For ventilators to let off the foul air at one part of a building, room, or window, and to admit the fresh air at another.

4th. To prevent the back draught in flues or vents of all sorts, and by that means keep the smoke of neighbouring vents from descending, and, in many cases, the vent from smoaking. Also to construct boxes or square tubes to put upon the tops, or other parts of vents, so as to open on one side and shut on the other, according as the wind blows.

5th. For sluices that are required to keep water out or in on either side, as the ebbing and flowing of the tide, when wanted to be dammed up for mills or other purposes, or in embankments to keep the water out on the one side, and to let it off from the other.

6th. For the bottoms of buckets or barrels to draw water with; which, if constructed on this principle, would not require being overturned before they can be filled.

And, lastly, this principle may be applied to any other purpose, by which it is required to obtain or to produce motion or power, by the alternate action and re-action of resisting and non-resisting surfaces in fluids of any denomination, or to produce effects by the alternate action and re-action of such fluids against surfaces of that description. In witness whereof, &c.

Specification

Specification of the Patent granted to ROBERT FRYER, *of Rastrick, in the Parish of Halifax, in the County of York, Woollen-manufacturer, and* JAMES BENNET, *of Oldham-street, in the County Palatine of Lancaster, Woolstapler; for a Method of manufacturing, cutting, dressing, dying, and finishing of Cloth, the Warp whereof is composed of Silk, Cotton, Woollen, Worsted, or Linen Yarn, and the Weft of Sheep's Wool or Lamb's Wool.*

Dated June 21, 1800.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, we the said Robert Fryer and James Bennet do hereby declare that our said invention of a new method of manufacturing, cutting, dressing, dying, and finishing of cloth, the warp whereof is composed of silk, cotton, woollen, worsted, or linen yarn, and the weft of sheep's wool or lamb's wool, is described in manner following; that is to say: Our new method of manufacturing, cutting, dressing, dying, and finishing, of cloth, the warp whereof is composed of silk, cotton, woollen, worsted, or linen yarn, and the weft of sheep's wool or lamb's wool, consists, first, by carding, roving, and spinning, in the common method now used in the manufactory of wool into yarn fit for weaving into cloth, which composes the weft. Secondly, after the weft is manufactured, it is wove into a warp or warps of woollen, worsted, cotton, silk, or linen yarn, which is woven by causing the weft or woof to float or pass over two or three or more threads of the warp, for going under, or being attached to the cloth only by one or more threads of the warp, which causes it to form a roll or figure on the face of the cloth.

Thirdly, the cloth so manufactured is then to be cut with a knife, or any other instrument, by introducing such knife or instrument under the roll or figure, and running the knife or instrument along with the hand, or by a machine, which cuts that part of the weft or woof which is left above such roll or figure, or afloat in the figure, and thereby produces a fine rich cover upon the face of the cloth; which method of cutting in the finishing of woollen or partly woollen cloth, manufactured with the before-mentioned materials on the same or any other principle, has never before been made use of. Fourthly, the cloth so manufactured is to be taken to the singeing-plate, which is an iron cylinder, in which is put a quantity of fire, to make the cylinder red-hot. When the cylinder is sufficiently hot, the cloth so cut must, fifthly, be drawn as quickly over the singeing-plate as possible, that it may not injure the body of the cloth, but may singe the surface of the cloth, and shorten that part of the weft or woof which has been cut to give it a fuller and richer appearance; and this operation of drawing the cloth as quickly over the singeing-plate as possible must be repeated several times, according to the heat of the singeing-plate, and the judgement of the workman or workmen; and all kinds of woollen cloth manufactured by carding, roving, and spinning, weaving, milling, and raising, either by the hand or by machines, may be finished after the same process, that is to say, by singeing instead of cropping or sheering; which method of finishing woollen cloth so manufactured is a new invention, and has not heretofore been practised. Sixthly, after the cloth is so finished, it must be scoured clean in a sud of soap, or lye and water, pretty warm, or a lye made from any other alkali fit for the purpose. It must then be well boiled a few hours in clean water, then is

to

to be taken out and dried, and, if found necessary, drawn over the singeing-plate a second time, and well scoured as before. Seventhly, the cloth is then dyed with any colour, at the discretion of the manufacturer. Eighthly, after the cloth is dyed and dry it must be well brushed, smoothed, pressed, or cylindered, as wanted, which finishes the process of manufacturing, cutting, dressing, dying, and finishing of cloth, the warp whereof is composed of silk, cotton, woollen, worsted, or linen yarn, and the weft of sheep's wool or lamb's wool, and which method of finishing cloth is also adapted to finish woollen cloth manufactured in the usual way. In witness whereof, &c.

On the Destructive Effects of the Aphis and Blights on Fruit-Trees; with useful Observations for preventing them. By THOMAS ANDREW KNIGHT, *Esquire, of Elton, near Ludlow.*

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

SO many writers on gardening, and on general agriculture, have treated on blights, and so many different theories have been offered to the public, that the subject may appear to many, to have been already sufficiently investigated. The Society, however, entertained a contrary opinion; and, having expressed a wish to receive farther information, I avail myself of this opportunity to lay before them some remarks, which I have at different times made, during several years of rather close attention to the subject.

What are usually termed blights, in the vague and extensive signification of that word, appear to me to originate from three distinct causes:—from insects, from parasitical plants, and from unfavourable seasons.

The destructive effects of the aphis on wall-trees are so well known to every gardener, as scarcely to require description. The leaves curl up, the fruit drops off, and the progress of vegetation is almost totally suspended. Much ill-applied labour is often used by the gardener to destroy these insects, though they are not very tenacious of life. Another more extensive, but less fatal disease in plants, the honey-dew, is produced by this insect (as described by the Abbé Boissier de Sauvages). It has, however, been contended, that the honey-dew is not produced by the aphis, but that it is a morbid exudation from the plant; at least that there are two kinds of it; because the leaves are often covered with honey on trees where the aphis is not found, and because the aphis is sometimes found without the honey-dew. But to this it may be objected, that honey, not being a volatile substance, will remain on the leaves till it be washed off by the rain; and, when moistened by the dew, will leave the appearance of a recent exudation; and that the aphis certainly does not afford honey at any period of its existence. I have frequently placed plates of glass and of talc under the leaves of fruit-trees, on which different species of the aphis abounded, and I have found these substances to be in a few hours covered with honey: and I have at other times distinctly seen the honey fall from the under-sides of the leaves, where these insects abounded, by the following means. Having placed a small branch, containing a numerous colony of insects, in the window of my study, where the sun shone strongly upon it, I closed the shutters

shutters so as to exclude all the light, but that which fell directly on the branch. In this situation the descending drops of honey became extremely visible by refraction, and appeared evidently to be emitted from the insect with considerable force. Each drop contained many minute white points, which I considered as the eggs of the aphis; but, as I knew that the modes of generation in this singular insect had much engaged the attention of naturalists, I did not examine with sufficient attention to decide that point. This species of insect appears to require a previous disposition in the tree to receive it; and its first attacks may thence be considered as symptomatic of a previous ill habit in the tree: for I have found that trees which have lately been transplanted, have totally escaped its attacks, when every other tree, of the same kind of fruit, growing in the same situation, has been nearly destroyed. And I can assert, from many experiments, that if every peach and nectarine tree was to be dug up once in every five or six years, and to be replanted with some fresh mould round the roots (which should be as little injured as possible), a much larger quantity of fruit, and of very superior quality, would be obtained. It is unnecessary to inform the experienced gardener, that the tree should be removed early in the autumn; that its branches should be considerably retrenched, and that it should not be suffered to bear a heavy crop of fruit in the succeeding season. I have never found any species amongst the numerous and prolific genus of the aphis, which was not readily destroyed on the wall-tree by covering it with a sheet of canvas, and under that introducing the smoke of tobacco. It is, however, necessary that the fumigation should be repeated twice or thrice, with intervals of four or five days. I have often seen the addition of sulphur recommended,

and have known it tried, but always with fatal consequences to the tree, as well as to the insects.

The blossoms of apple and pear-trees are often said by farmers to be blighted, when they are destroyed by insects, which breed within them, or in their fruit; and the same term is used, when the leaves have been eaten by the caterpillar: but as the insects themselves, as well as the manner in which their depredations are made, are extremely obvious, they do not properly come under our observation when treating of blights.

The species of parasitical plants which are found in the form of disease on other plants, appear to me greatly to exceed the number of those I have any where seen described by botanical writers. Of these the mildew is the most common and obvious. If a branch, infected with this disease, be struck by the hand in calm dry weather, a quantity of white powder will be found to fly from it; and if this be received on a plate of talc, or of glass, and examined by the microscope, it will be found to consist of very numerous oval bodies, evidently organized. There is another plant similar to this in every thing but colour (being of a tawney brown), which is not unfrequently found on the leaves of young apple-trees. Both these plants appear to me to be evidently species of mucor; and as much the greater number of species of this genus of plants is found to flourish in damp air, and in situations deprived of light, it may be supposed that the foregoing diseases might be prevented or removed, by placing the plants at proper distances: but I have not found this to be the case. They, however, abound most in low and sheltered situations; but they are not unfrequently seen in those of an opposite kind. The red and white mould on hops, and the black spots on stalks of wheat (the rubigo of Virgil), and many other diseases of plants,

will,

will, I think, be found to arise from the attacks of minute plants of this genus, which appears to me to possess qualities somewhat similar to the digestive powers of animals.

The most common and extensive causes of what are termed blights remain still to be described, and evidently exist in the defects and sudden variations of our unsteady climate. Whatever be the cause by which the sap is raised and propelled to the extremities of trees, it is well known that its progress is accelerated by heat, and that it is checked, or totally suspended, by cold; and it has been ascertained by others, as well as by myself, and indeed is known to every experienced gardener, that a plant under the most skilful management does not readily recover its former vigour, when it has been injured by exposure, for a few hours, to a temperature much below that to which it has been previously accustomed. It frequently happens in this climate, when the blossoms of our fruit-trees are just expanding, that a very warm day succeeds a night whose temperature has been some degrees below the freezing point of water. In such a day the evaporation from the unfolding leaves and blossoms will be greatly increased by the agency of heat and light, whilst the supply of nourishment is in a great measure cut off by the ill effects of the preceding night. The blossoms will nevertheless unfold themselves, but will be unproductive, from the want of due nourishment; whilst the hazy appearance of the air, which almost always accompanies such weather in the spring, will induce the gardener unjustly to infer that the ill effects he observes have arisen from some quality in the air (distinct from excess of heat and cold), which he denominates a blight.

The best defence against this kind of weather for wall-trees, that I believe has yet been tried, is a covering of a

double

double and triple net; for by this the tree is in some degree protected from frost; and the excess of evaporation, in the succeeding day, is, in a very considerable degree prevented. Lightning is supposed by many to be very highly injurious to the blossoms of trees; but I believe that the ill effects which appear sometimes to accompany it, may be more justly attributed to excessive heat. The careful gardener often covers his trees with mats, or something of this kind; and by almost totally depriving the tree of light, creates that blight which he is anxious to exclude.

As the blossoms of every tree are formed during the preceding summer and autumn, they will evidently be more perfect in proportion as those seasons have been favourable, and as the management of the gardener has been judicious: and as the power of bearing unfavourable weather will be proportional to their vigour, and to the maturity of the annual wood, through which the sap passes to support them, the gardener should be (though he rarely is) extremely attentive to keep his trees in such a state, and the branches at such distances from each other, that they may receive the greatest possible benefit from the portion of light and heat which our shadowy climate affords them. It frequently happens in pruning, that too much bearing-wood is left on the tree. Every gardener ought to know, that where a hundred fruits are a sufficient crop for a tree, he has a better chance to obtain that hundred from one thousand blossoms, to which the whole nourishment of the tree is directed, than when the same quantity of nourishment has to support a hundred thousand.

In standard fruit-trees, where no advantages can be derived from covering them, much may be done by the judicious application of the pruning-knife. The branches of a tree of this kind ought to be much thinned towards their

their extremities, so that the light may be admitted into the centre of the tree; but the internal parts of it should never be so thin as to admit of a free current of air through it. When a tree has been properly pruned, blossoms and fruit will be found on every part of it: and, in unseasonable seasons, the internal blossoms will receive protection from the external branches, which will be unfruitful.

It is particularly the interest of every planter, to take care that the varieties of fruit which he plants be sufficiently hardy for the situation in which he places them; for, if this be not attended to, little benefit will be derived from the foregoing observations.

On the Naturalization of Plants. By JOHN TEMPLETON, *A. L. S. communicated by the Bishop of Clonfert.*

From the TRANSACTIONS of the ROYAL IRISH ACADEMY.

THE naturalization of plants is an object of such importance, and a subject that is at present so little understood, that any attempt to extend our knowledge of it, however trifling, may still tend towards improvement, and perhaps serve as a foundation, on which at some future period a more perfect structure may be erected. Many experiments are yet wanting; much remains to be yet done; and, like other branches of knowledge, it will require the united efforts of numbers to bring it to perfection.

The same Almighty Hand that formed the earth has scattered in far distant regions vegetables which the necessity or luxury of man excites him to endeavour to accumulate about his home. And if we at the present time

time survey the different nations of the earth, we shall find that most of them have received great and important benefits by the introduction of foreign plants; and that there is no country, however numerous its collection of plants, but may yet receive considerable advantages by the naturalization of others.

Botany, a science which every one engaged in the study of will readily acknowledge to afford one of the purest of human pleasures, from the introduction of exotics derives its principal support; and certainly whatever tends to facilitate this amiable study is truly deserving of the attention of every philanthropic mind. As all botanists cannot have an opportunity of examining plants in their native soils at proper seasons, it is therefore only by transplanting and cultivating they can become acquainted with the productions of distant countries; and to cultivate them with success we must derive our information principally from the plants themselves; each has certainly a peculiar character, which were we truly acquainted with, those tedious experiments with each newly acquired species, which now nearly exhaust the patience of all lovers of plants, would be no longer necessary; gardening might then boast of being established on scientific principles, and would then never adopt rules contrary to what nature dictates.

By our present imperfect knowledge of the physiology of plants, we are necessitated to accept of every assistance within our reach: and plants being so immediately connected with every modification of the atmosphere, meteorology, which has hitherto been considered as an object of curiosity, is a source from which we may derive much useful information.

Heat being found to increase or decrease nearly in a regular progression, according to the degrees of latitude, if

if the latitude of the place where a plant is found be known, by consultiug Mr. Kirwan's Table of the Mean Annual Temperature of different Latitudes*, we may find whether the temperature nearly corresponds with our own. Or, supposing the mean annual temperature of Dublin, lat. 52°, equal 50 of temperature, by adding one for every degree of latitude southward, and subtracting one for every degree of latitude northward, we have the temperature correctly enough for our purpose. For these calculations need not be carried to the greatest degree of correctness, as we know that, if we except a few, plants have a considerable range of latitude, those which cannot bear frost being found to extend from the northern to the southern verge of the torrid zone, and many of those which grow on the southern limits of the temperate, to approach the borders of the frozen zone. Thus of the Lapland plants, near three hundred are found in the environs of Paris †: many of them much farther south, and some, as the Water Lillies (Nymphæa), Sundew (Drosera), Arrow-head (Sagittaria), &c. even natives of India ‡.

In the lattitude 44° on the European, and 34° on the American continent ¶, it is not unusual for water to be frozen in January; and as some seasons are much more severe than others, plants growing considerably farther to the southward would be liable to suffer by cold in such seasons, if nature had not provided a remedy by their manner of growing, which enables them to resist the cold of such rigorous seasons; and on this account many of

* See an Estimate of the Temperature of Different Latitudes by R. Kirwan, esq. page 17.

† See Flora Lapponica and Thuillier's Flore des Environs de Paris.

‡ See Hunter's Evelyn's Sylva, p. 552.

¶ See Kirwan on the Temperature of Different Latitudes, p. 50.

them will be found to thrive, when transplanted nine or ten degrees further north than their native stations.

From antient authors it appears that Italy formerly experienced the same degree of cold as the American continent under the same parallel of latitude does at present. Therefore it is highly probable, that Italian plants, not introduced into Italy since that time, might in a series of years be changed from their now tender to their once hardy state.

But in conducting such an experiment as the naturalization of plants from a southern to a northern climate, so many minute circumstances require our attention, that few people have either time or patience to reach the wished-for goal.

But a careful attention to the characters which the plants themselves present, will enable us to proceed with more certainty, and hopes of having our endeavours crowned with success.

By the appearance of the roots and leaves we may nearly determine in what kind of soil the plant is most likely to thrive. Robust roots and fleshy or rigid leaves require a dry soil, according to their thickness; stiff clay or sandy loam, as beans, peach, and apple trees; robust spongy roots which have a tendency to mat near the surface with thin leaves, as the Alder (Betula Alnus), Willows (Salix), require a somewhat stiff soil with moisture; many of the Salix genus will not grow with their accustomed vigour in a light turfy or peat mold soil, for want of the necessary resistance to the roots, although suitable in respect to moisture. Slender, hard and wiry roots, as those of the pine, Cistus, &c. require dry, sandy, or gravelly soils. And extremely fine and hair-like roots, as those of Erica, Halmia, Rhododendron, &c. must have a soil whose particles will not impede the

shooting of their tender fibres, and with a small but regular degree of moisture, that the roots, which by their form cannot resist the slightest drought, may not be destroyed. Plants in a warm climate perspire more than in a cold one; so in a warm they require much, and in a cold one little moisture. Therefore, when transplanted from a warm to a cold climate, they should have a drier soil, and from a colder to a warmer, a moister one, than their native station.

In the first case, not being able to perspire the superabundant moisture, they will be rotted; and in the last, not having moisture sufficient to supply the loss by perspiration, the growth will be slow, disease and death will follow, unless they receive a timely supply of moisture; by the red or yellow colour of the leaves we may discern the approach of the first evil, and by the stunted growth, and small curled leaves, that of the last. A large quantity of pure circulating fluid seldom injures plants, but stagnant water is certain destruction to almost every vegetable.

After having determined the most suitable soil, we must afterwards strive to give each plant a proper situation. It is well known, that plants from a shady will not thrive well in an open, nor plants from an open in a shady situation. But the necessity of a natural situation is by no plant more evidently illustrated than by the common myrtle (Myrtus Communis.) Even at Glenarm, in the latitude 54° 56′ N. it grows with great luxuriance contiguous to the sea, and braves our coldest winters; yet all attempts to naturalize it in an inland situation, several degrees farther south, and in a much more genial climate, have hitherto proved unsuccessful. The olive tree cannot possibly be cultivated in the interior of Asia or America, though the latitude be in other respects favour-

able, nor is it fruitful when excluded from the sea breezes *.

The cause of this may be that near the sea the temperature is more regular than within land, and sudden changes are perhaps unfavourable to evergreens: for we always find those with broad leaves grow best in the shade, and those with narrow leaves on elevated places, in both of which situations the temperature is more regular than in open exposures or confined vallies. And we may often observe plants growing on a somewhat elevated situation, if sheltered from strong winds, less hurt in a severe winter, than others in low warm and sheltered places. For vapour being raised in such places during the day, produces a greater degree of cold by condensation and evaporation in the night, than is experienced in other places where the coldness of the air prevented the rise of vapour during the day. From every observation it appears, that those plants which have the least sap in winter, or whose sap is of a resinous or oily nature, suffer least from cold, and that the principal cause of destruction is the vessels being burst by the freezing of the sap. The hoar-frost, which is always most abundant in vales, tends in a great degree to promote this; for, being changed into water, part only of this water is evaporated during the day, the rest remains to be converted into ice by the cold of the ensuing night. This icy covering increases the cold, till the vital principle †, and resistance given by the formation of the bark to the entrance of cold, are overcome, the sap frozen, and at the same time the vessels burst by the expansive force of freezing. This

* See Saint Pierre's Studies of Nature, translated by Hunter, vol. I. page 607. Dublin edition.

† See Smith's Tracts relating to Natural History, page 177; and Philosophical Transactions for 1788.

gives

gives the reason why plants in a situstion where the sun does not shine on them to thaw the hoar-frost, suffer least in severe seasons; and that plants removed in Autumn, unless the shoots are completely hardened, will be more liable to be injured by frost than those of the same species, the descent or fixation of whose sap has received no check by transplanting. Miller remarks, that those plants which were removed in the Autumn of 1739 were mostly killed by the cold of the ensuing winter, while many of the same species escaped uninjured: and the same may be always observed after every severe winter *.

Few deciduous shrubs agree with shade: their natural place is the sunny outskirts of the forest: and when otherwise situated, long and slender branches, with large thin leaves, shew their unhealthy state. From these the climbing plants are easily distinguished by their tendency to contortion, or shooting forth roots or tendrills. To the deciduous climbers a slight shade is not hurtful, as it is only there they can find the necessary support; but in the deep recesses of the forest, the evergreen climbers will spread around their tangling branches, and thrive with wild luxuriance, never appearing, if the soil is sufficiently moist in summer, to be hurt by the thickest shade of deciduous trees.

The shade is also the natural situation for young plants. By the parental shade they are protected from the drought of Summer, and the cold of winter. The more a plant is

* The following experiments may throw some light upon the cause of plants remaining unfrozen, when the surrounding water is frozen. Water enclosed in sealed glass globules remains unfrozen, 'till the thermometer descends to twenty-four; unsealed ones freeze and burst immediately on being cooled down to freezing water. Oil inclosed in the same kind of globules continued unexpanded, and consequently the globules unbroken, when placed in a mixture of snow and sal ammoniac, and cooled below 0.

shaded

shaped in winter, and the nearer it is to any large body, the less danger it will be in of suffering from frost. For when a plant or water is so situated as to be overtopped by trees, a great part of the hoar or frosty particles, which would fall on it, is intercepted. Under trees we may often observe water unfrozen, and plants unhurt by the severity of cold, and many retaining their leaves; when water at a small distance is frozen, and plants of the same species, but unshaded, lose their leaves and suffer considerably. As large bodies are not easily cooled, the cold is in some degree mitigated by the stems of large trees. That this is the case may be perceived, the twigs and smaller branches being covered with hoarfrost, when the trunk and larger branches remain uncovered.

Dr. Wilson of Glasgow observed, that when a great degree of cold prevailed, palisades extending outward from a house, and also from a large pillar, were covered with hoarfrost, in the most regular manner, according to their proximity or distance from the house or pillar, those next the house or pillar remaining free from hoarfrost, while the more distant ones were entirely covered *. This accounts for the fig-tree shoots, mentioned by Miller, being killed when growing out from the wall, at the same time when the other shoots close nailed to it escaped unhurt †. From this circumstance, most people have affixed those plants which they wish to naturalize to the climate against walls. But when put to a wall, care should be taken that they are sheltered from strong winds, which generally injure the leaves and young shoots, thereby destroying the plant if it is not vigorous. On this account the stems of large trees are preferable for climbing plants, and

* Philosophical Transactions, vol. lxx, p. 471, 2.

† Miller's Dictionary, article Ficus.

there

there they must always be more admired as appearing more natural.

But instead of affixing to walls those plants which require no support, we might cultivate them in pots or boxes, which may be placed in their proper exposure during the summer, and, until their hardiness is determined, removed under the fir or other trees in winter, the thickness of whose shade ought to be proportioned to the apparent tenderness of the plant.

These pots or boxes should be always sunk in the earth, and in winter the surface covered with moss. The drier the ground the better, for sunken pots are liable to be too damp.

The best manner of treating Ericas is to place them in a proper situation in the spring, and on the approach of severe weather to fix branches of spruce-fir about them, augmenting the covering as the cold increases. But as the cold seldom becomes suddenly severe, and a slight frost does them little injury, the Erica Tubliflora, one of the most tender, bearing about 29° of Fahrenheit's thermometer; it is best not to begin covering too soon, lest, as they are plants that require a very small degree of heat, they should be made to shoot, in which case the slightest frost will perhaps destroy them. To protect herbaceous plants from frost, moss is the most proper covering, by remaining alive through the winter; even after being pulled up, it is not liable to heating and putrefaction, as all dead vegetable substances are, by which they impart to the plant heat and moisture (the two principal agents which cause vegetation) thereby putting the vegetating powers in action, and filling the plant with sap, at an improper season. In our culture of annuals our only care is directed to placing them in proper soils and exposures. For, that no region of the earth should remain

main uninhabited, with a liberal hand have the annual plants been distributed; from these do men and animals derive their principal support, and of all the vegetable kingdom, they are best adapted for naturalization. By bringing their seed to perfection in a single season, they are capable of cultivation in a greater variety of climates than any other vegetables. And the seed, being equally undestroyed by natural heat and cold, lies dormant, till genial weather calls forth its latent powers, and urges it to vegetation, whether among the frozen snows of Siberia, or the burning sands of Africa. The Reseda odorata (Mignionette), a native of Egypt, and Helianthus annuus (Sunflower), of Mexico and Peru, ripen their seed, and are thereby perpetuated in our northern latitudes. St. Pierre * says, the peasants of Finland cultivate tobacco (Nicotiana Tabacum), with success, beyond the sixty-first degree of latitude; and that barley succeeds in the very bosom of the North. Amidst the rocks of Finland he saw crops of this grain as beautiful as ever the plains of Palestine produced †.

When we endeavour to naturalize plants, that we may distinguish those which offer the fairest prospect of success, a comparison of the exotics with the natives of the soil will be our surest guide. Thus we find, that throughout the frosty regions of the north, the trees, shrubs, bulbous and perennials, complete their shoots, and, before the cold of the winter commences, enclose in hybernacule or scaly buds, the embryo for the coming year. And there is every reason to believe that all exotics which cease growing, and form these buds or hyber-

* See St. Pierre's Studies of Nature, translated by Hunter, Dublin edition, vol. I. p. 604.

† See same Work, p. 667.

nacule

nacule in the open air during the course of our summer, will not suffer from the severity of our winter. In the hot-house many plants complete their shoots that would not probably do so in the open air, the heat not being sufficient to cause them to grow with the vigour necessary for their completion before winter. Nevertheless many of these, if not all, might be brought, by inuring them to the open air, to bear our climate. The Camelia Japonica Thea viridis and Calycanthus præcox, which were formerly kept in the hot-house, then in the green-house, are now sufficiently naturalized to grow in the open air, and are as little injured with the cold of our winters as either the common or Portugal laurels.

Some exceptions to this observation seem to present themselves. The Robinia Pseudo Acacia (two-thorned Acacia) does not form external hybernacule, nor complete its shoots, yet grows well in our climate; it however, when the frost comes on early, loses a great part of its summer shoots. Several species of the Cistus, that cease growing on the approach of winter, but form no hybernacule, live through our mild winters, but suffer greatly in severe frosts. And others, as the Laurustinus (Viburnium tinus), continue to shoot and flower, unless the frost is severe throughout the winter, sustained by their vitality, or that principle whose existence preserves plants unhurt by cold before flowering, but which ceases to exist when the parts of fructification have performed their office *.

The Laurustinus is one of those plants that were introduced to Ireland before green-houses were known, consequently planted in the open ground, and experience shews that it is seldom hurt by frost. By it we find that

* See Smith's Tracts, p. 177, and Philosophical Transactions for 1788.

some plants, which to appearance are not fitted for our climate, do yet outlive our winters; and that, without a knowledge of their native stations, we may sometimes suppose plants to be tender which are really hardy: thus the Laurustinus is unhurt by frost in Ireland until the cold exceeds that of its own climate. The Buddlea globosa and Fuschia coccinea are other instances of plants, that without a knowledge of their native climate, Chili, we would not suppose capable of being naturalized to ours. Yet is the Buddlea seldom injured by our cold, and the Fuschia, although killed to the ground by the winter's cold, sends forth abundance of shoots, which attain the height of three feet in summer, and are decorated with its elegant flowers, which are larger and much more brillant than ever they are when confined in a house.

And there is little doubt but many plants of Chili, and even those which grow within the tropics, when found near the elevation of perpetual frost, would bear the cold of Spitzbergen; for on the tops of mountains are found the plants of the plains of more northern latitudes. Thus is the Salix herbacea of Lapland and Spitzbergen found on the tops of Mourne mountains at about the elevation of 2,500 feet. On the Serra of Maderia, latitude 32°, 38', and elevated 5,162 feet, is found the Erica Arborea, of the neighbourhood of Genoa, latitude 44°, 25'*. Therefore as the temperature which prevails at the elevation of 5,162 feet, in latitude 32°, is found nearly to correspond with that of 51° north: the Erica Arborea, which grows at that elevation in latitude 32°, will find a climate suited to its nature in latitude 51°†. But as the before-mentioned

* See Sketch of a Tour on the Continent, by J. E. Smith, M. D. F. R. S, &c. page 200, vol. I.

† On dividing 15,577, the height of perpetual frost at the equator, by the difference of the temperature above and below, it is found that every

mentioned plants have a considerable range of latitude, it may be cultivated farther north when the soil and situation are favourable. At James Holmes's, esq. on the eastern shore of Carrickfergus bay, four miles north of Belfast, there is a plant in the greatest vigour at the present time (July 1799) which has now stood uninjured three as severe winters as Ireland ever experienced, viz, 1794-5, 1797-8, and 1798-9.

The situation is however favourable, being against a western wall facing the sea, and well sheltered by distant trees from strong winds. And in the neighbourhood of the sea I have little doubt but it would grow still farther north.

The sea air has generally been reckoned a powerful obstacle to having plantations on its shores. But many observations have convinced me that it is the wind alone which prevents the growth of trees on the shores of the sea. And that on a large plain, where the winds are unimpeded in their course, the same difficulty of raising plantations as on the margin of the ocean will be experienced.

In Forster's account of Cook's second Voyage, it is mentioned, that the trees on New Zealand were growing so close to the edge of the water, that the ship's masts were entangled among their branches; and in particular situations the same proximity of trees to the sea might be observed in various latitudes. At Fairhead, the most northerly extremity of Ireland, and exposed to the fury of the Northern Ocean, the Sorbus aucuparia (Mountain Ash),

every 299 feet of elevation lessen heat 1°, and on dividing 5,162 feet by 299, we have 17°, which, subtracted from 69 mean annual temperature of latitude 32°, give 52, for the Serra of Maderia, corresponding with the latitude 51° (1).

* See Kirwan's Table of mean annual temperatures.

Ash), Betula alba (Birch), Quercus Robur (Oak), with other indigenous trees, grow luxuriantly within 15 or 20 yards of high-water-mark. The reason of this appears to be, that they grow upon the lower part of very high land, which causes an eddy to be formed about them when the wind blows from the sea; and by the same high land they are protected from the south and south-west winds.

On the top of the rocks the wind rages with the greatest fury, even the grass seeming blighted, whereas below the rocks every plant appears in a thriving state, and some houses sitnated on the lower part never have their thatched roofs disturbed by the storms. In every other part along the coast where land is of the same form it is covered with thriving wood; but where the land is nearly level for a length of way inland no wood appears, and every hedge is seen never to rise higher than the top of the bank which protects it from the wind. Therefore in order to plant near the sea on a low shore, it is necessary to commence the plantations a considerable way inland, and to allow the young trees to have others several feet taller than themselves behind them: these will have the same effect as high land, for by means of the opposition offered by innumerable stems and branches, the force of the wind will be greatly lessened; as we may find by standing on the windward side of a thick wood during a storm, where, if the trees are lofty, the wind is much less violent than on an open plain. In water the effect of this kind of opposition is visible, for if into the bed of a swift stream we drive a number of stakes, the water, although it continues to flow, yet has its velocity diminished considerably.

Our first plantations in an exposed place ought always to be of such trees as are natives of mountains, for these are fitted by nature to bear the rude blasts of winter, and by the

the stiffness of their leaves, or flexibility of their foot-stalks, to remain uninjured by a summer storm. Of the first, we have the various race of pines; of the last, the Birch, the Aspen, and the Mountain Ash*.

Thus by a careful inspection of the operations of nature, is the hand of man enabled to collect the productions of distant countries around his home, cover the arid heath with waving green, and make the lonely wilderness assume a pleasing gloom.

An Account of an Experiment on the Velocity of Water flowing through a Vertical Pipe.

From the JOURNALS *of the* ROYAL INSTITUTION *of* GREAT BRITAIN.

IT has been asserted by some writers on hydraulics, and Venturi describes a particular experiment in support of the assertion, that the discharge of water running out of the bottom of a cistern, through a descending pipe, is nearly the same as if the cistern were continued through the whole height, from the surface of the water to the orifice of the pipe, and the water were then discharged from the bottom of this cistern by a short pipe in any direction. The apparent difficulty of finding a cause adequate to the effect, on the one hand, and the authority of Venturi on the other, made it desirable that the experiment should be repeated; and an apparatus was con-

* Among the rocks of Agnew's Hill in the County of Antrim, I found the Populus tremula (Aspen Tree) growing luxuriantly on the eastern face, at about the elevation of 1,450 feet. And on the top of Slemish, the Sorbus aucuparia (Mountain Ash) exposed to every storm at the elevation of 1,398 feet.

structed,

structed, in the house of the Royal Institution, for performing it in a simple and satisfactory manner. The cistern employed was a cube of nine inches: close to the bottom a cylindrical tube was inserted, in a horizontal direction, nine inches in length, and half an inch in diameter; another tube, of exactly the same dimensions, was provided with a flat funnel at its upper end, and its lower end was fitted to slide in a collar placed in one of the upper angles of the cistern, so that it was supported in a vertical position. Water was poured into the funnel as fast as it could be transmitted through the tube; and, as the surface of the fluid rose in the cistern, the vertical tube was drawn up, so that its lower orifice was barely immersed in the water. It was expected, that if the velocity of the water in the vertical tube were equal to the velocity corresponding to half its length, the water in the cistern would stand at the height of four inches and a half, or one half of that length, and that the pressure of this head of water would generate, in the water flowing through the horizontal tube, nearly the same velocity as the column of water would acquire in its descent through the vertical tube: the friction and resistance being in both cases the same.

But the result was far different, and it fully confirmed the truth of the received theory: for the water rose in the cistern to the height of eight inches, which was very nearly the length of the tube. It is true, that the water had already some velocity when it entered the funnel;

but

but most of this must have been lost by reflection from its sides and bottom; and the quantity of air bubbles, that were unavoidably carried down with the water, must have fully compensated the little that remained.

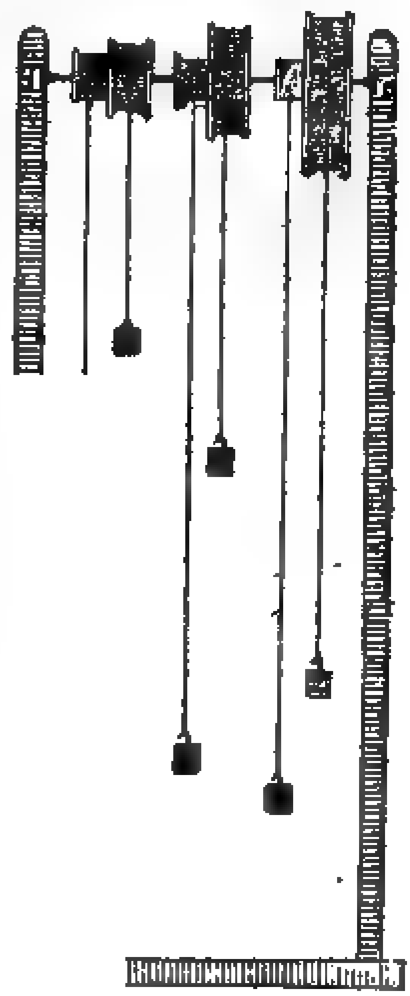
The water acquires all its velocity, in consequence of the pressure of the atmosphere acting jointly with its cohesion, in a very small space at the entrance of the tube: consequently, during the whole time of its descent it acquires no new motion, and the whole force of its gravitation must therefore be at liberty to act in any other way; hence the whole column produces the same degree of pressure as if it were at rest, and causes the atmosphere to press on the water above it in proportion to its whole height, in the same manner as if the pressure were derived in any other way from an equal column of water; and the case is reduced to a perfect analogy with the pressure of a head of water of this height, since the air acts upon the particles entering the tube in the same manner as the water does in more common cases. Had the result of the experiment been different, it would have been an exception to the general principle of the preservation of living force, or the equality of the potential ascent to the actual descent; for the water, moving with the velocity due to half the height only, would have been capable of ascending but to half the height.

Description

Description of Dr. Young's *Apparatus for illustrating the Doctrine of Preponderance.*

From the Journals *of the* Royal Institution *of* Great Britain.

ALTHOUGH there can be no doubt of the truth of the mathematical conclusions, which have been deduced from the well known laws of motion, respecting the most advantageous employment of force in machines, yet they have, in general, been too little considered in practical works, and scarcely ever enforced by experimental illustration. The apparatus contrived for this purpose derives its advantage from the simplicity of its operation, and the facility of observing at once the several motions which begin at the same time, and may easily be compared, as long as they continue. The ratio of the portions of the middle pulley, which is that of 5 to 2, is near enough to the maximum $(\sqrt{2}+1):1$; and the other ratios 3:2 and 4:1 are taken sufficiently different from this to show that the velocity of each is inferior to that of the middle pulley. The pulleys are all perforated in the



the axis, and move freely on a strong polished wire, supported by two short arms, projecting a little from two upright pieces about three feet in length, in order that the descending weights may proceed without interruption beyond the edge of the table.

Six equal weights were attached to as many threads, and each pair of threads was passed in opposite directions round the different portions of three pullies. The first pulley was so formed that its large portion was to its smaller as 3 to 2, the second was in the ratio of 5 to 2, and the third as 4 to 1; and the three weights, of which the threads were coiled round the smaller part of each pulley, being suffered to rise at the same instant, the middle weight rose evidently much faster than either of the others. Dr. Young however remarked that the greatest velocity would not in all cases be practically desirable, on account of the injury that the machinery would sustain from the shock in stopping it.

Substance of an Essay lately published respecting the Construction, Hanging, and Fastening of Gates and Wickets, &c. with Supplementary Improvements. Communicated by the Author THOMAS N. PARKER, *Esq. M. A.*

With a Plate.

" Studium quibus arva tueri." Virg. Georg. I. 21.

ON the Principles here laid down, a Gate is considered as a lever of the second kind; and when suspended by hooks or pivots precisely perpendicular to each other, it will be at rest wherever it may be placed: but by the smallest variation of the hooks from their perpendicular position (provided it be sufficient to overcome the friction) a gate will acquire one determinate line of rest, and an opposite line of equilibrium; and consequently, from any part of a circle which a gate so suspended may be made to describe, it must have a constant tendency to fall to that line of rest.

When a gate is in its line of rest, or opposite line of equilibrium, the hooks and the centre of the gate's gravitation will be in one and the same vertical plane; and when the hooks are perpendicular to each other, it can admit of no doubt, that they must be in the same vertical plane with the centre of the gate's gravitation, because they will be so with any third given point whatsoever.

The requisite velocity for the fall of a gate which opens but one way, is obtained by an extra length of the lower thimble, or more properly, by the horizontal distance of two perpendicular lines, one falling from the centre of each of the hooks or pivots upon which a gate is suspended; and the proportion is not to be determined so much

by

Fig 10

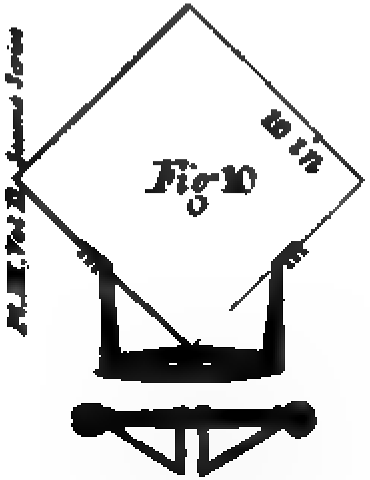


Fig 6

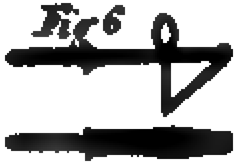


Fig 7

Fig 2

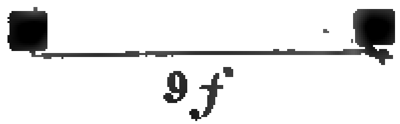


Fig 3

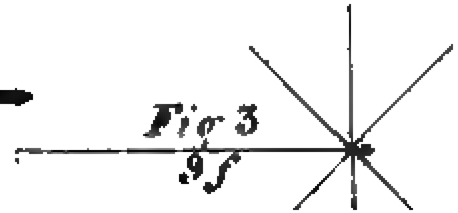
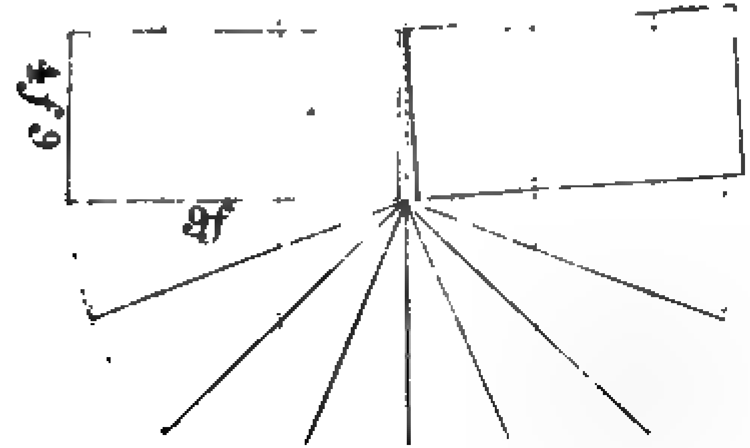


Fig 11

Fig 1



by the length and weight of the gate, as from the distance of two hinges from each other: about a quarter of an inch must also be added to the extra length of the lower thimble for what is lost in the hanging of the gate, exclusive of the perpendicular difference of the two pivots *.

A gate nine feet long should rise at the head in opening, about six inches, by which it will acquire a sufficient tendency to fall to its line of rest; and supposing the hinges to be 40 inches asunder, it follows, that as the length of the gate is to the difference between the height of the head of the gate when in its natural line of rest, and the height of the head of the gate at its greatest elevation, or opposite line of equilibrium; so will be the distance of the two hooks to double the clear extra length of the lower thimble: that is, reducing it to inches, as 108 : 6 :: 40 : $2\frac{2}{12}$ †: therefore, this extra length of the lower thim-

* The velocity given to the gate's fall by the extra length of the lower thimble, is calculated for such hinges as are rounded off and well finished; it being now ascertained "that the smallest surface will have the least friction." See Mr. Vince's Experiments "on the Motion of Bodies affected by Friction." Vol. LXXV. Philos. Transac. of Royal Society of London.

† As it will scarcely be possible in common practice, to be more exact in hanging a gate than to a twelfth part of an inch, I have omitted all greater fractions; that is, the integer of one inch will in no case be divided into more than 12 parts, which I propose to make a general denominator for all broken numbers.

And it may not be amiss to observe in this place, that the compound nature of a gate's motion, which proceeds necessarily from the position of its hinges, or the two centres of its suspension, with respect to each other, cannot readily be defined with an accuracy perfectly mathematical: but it will be found capable nevertheless of plain and satisfactory explanation, abundantly near enough to the truth for every practical purpose

ble should be $1\frac{4}{12}$, including the $\frac{3}{12}$ allowed for what is lost in the hanging. From this proportion may be deduced any other; for example: if the distance of the two hinges were 30 inches, then the extra length of the lower thimble would be $1\frac{1}{12}$; because as $40 : 1\frac{1}{12} :: 30 : \frac{10}{12}$, and $\frac{10}{12} + \frac{3}{12} = 1\frac{1}{12}$, supposing a gate to be a right-angled parallelogram, or equivalent thereto as far as regards its upright suspension.

A gate being thus hung, will not fall with an uniformly accelerated motion as might be imagined, but with a velocity somewhat increased towards the middle part of its semi-circular course, and retarded again in approaching its line of rest, coinciding with a proportionate rise of the head of the gate *; one half of which rise or 3 inches is attained in the first half or 90° of the gate's semi-circular motion from its line of rest, and the other half or 3 inches is added in completing the supplementary arc of 90°, but subject to certain variations in the intermediate parts of the gate's motion, *viz.*: as the *versed sine* of the angle formed by the gate with its line of rest, is to the length of the gate which is made radius, so will be the corresponding rise of the head of the gate to 3 inches, at any given angle within the quadrant: and the rise of the head of the gate afterwards will be; as the *co-sine* of any given angle formed by the gate with its line of equilibrium, is to the length of the gate or radius, so will be the corresponding rise of the head of the gate to the remaining 3 inches †. And by calculation it appears that the rise of the head of the gate will be as fol-

* Allowing only for such acceleration as may be acquired while the gate, in falling with a continued motion, recedes more and more from the line of equilibrium.

† See fig. 1, plate III.

lows

lows in each 22° 30′ or $\frac{1}{8}$th part of its semi-circular motion from the line of rest to the line of equilibrium:

In the 1st.	22° 30′	it will rise	$\frac{3}{12}$ *	of an inch.
2d.	ditto	ditto	$\frac{7}{12}$	
3d.	ditto	ditto	1	
4th.	ditto	ditto	$1\frac{2}{12}$	
5th.	ditto	ditto	$1\frac{2}{12}$	
6th.	ditto	ditto	1	
7th.	ditto	ditto	$\frac{7}{12}$	
8th.	ditto	ditto	$\frac{3}{12}$	
Total -	180° will give the rise of		6	inches.

Fig. 2 represents the horizontal section of two gate posts with black spots where the hooks ought to be placed, the falling post meeting the gate at $\frac{1}{8}$th of the semi-circle or 22° 30′ short of its line of rest, the better to resist the effects of wind: the upper thimble being placed about half an inch nearer to the hanging post, and the upper hook proportionably shorter than the lower one, the gate will be upright when fastened, notwithstanding it be so much short of its line of rest.

Half an inch may be ascertained to be the proper allowance for the above purpose, thus: take a common horizontal distance of two perpendicular lines one falling from

* Though the length of the gate be 108 inches, and the rise of the gate in the first 90° of its motion $\frac{36}{12}$ths of inches, yet in the first 22° 30′ of its course, the head of the gate will rise only $\frac{3}{12}$: for to the logarithm of 108 add the sine of 67° 30′, and from their sum subtract the sine of 90°, the remainder will be the logarithm answering to the number 99; which being deducted from 108 will leave 9; then as 108 : 36 :: 9 : 3 — and in like manner may similar calculations be proved as they occur in this article.

from each of the hooks $1\frac{2}{12}$ths inch, to which I have an angle of 22° 30′ given, and a right angle parallel to the insertion of the upper thimble into the heel of the gate is assumed of course; upon this data I complete the triangle, and find that the given line being $\frac{14}{12}$ths of an inch, the line determining the new position of the upper thimble must be $\frac{6}{12}$, and the diagonal line, or line subtending the right angle will be $\frac{15}{12}$; thereby adding $\frac{1}{12}$ of an inch to the horizontal distance of two perpendicular lines one falling from each of the hooks, which is not material, as many of my readers would be disposed to sacrifice a little more wear and tear of their gates to increase the velocity of a gate's fall, and in some measure provide against high winds.

In Fig. 2 a short post is represented to prevent the gate opening beyond the $\frac{1}{8}$th part of the semi-circle short of the line of equilibrium, which may be placed still further within that line, as convenient; for if a gate's line of fastening be as usual, at right angles to the road, the gate need not open wider than from 22° 30′ to 45° beyond the quarter circle, for any occasion. A left-handed gate will admit of the same explanation, by reversing the form of the hinges, as may be seen by looking at Fig. 2 against the light from the wrong side of the plate.

The above observations in a great degree apply also to a swing gate, as at Fig. 8, and the lower hinge is more particularly represented Fig. 9; in the one part of which two hooks and an open groove are seen, and the other is placed diagonally to shew an iron peg, made to fit into the groove, whereby the objection of a swing-gate being easily taken off the lower hinge, when two centres are used there, is done away.

Fig. 3 represents a pair of hinges by two black spots, in order to shew, that a hammer applied in any direction of

of the lines drawn through one of the hooks, will have the contrary effect of a blow given to the other hook in the same direction, as is marked by dotted lines, upon the principle with which we set out; that the two centres of a gate's suspension and the centre of the same gate's gravitation, when in its natural line of rest, will be found to be in the same vertical plane.

Fig. 4. The best constructed gates are most apt to be acted upon by the wind, from the extent of surface which they present to it; and I know of no better pattern than that of Fig. 4, wherein the top rail is supported by a long diagonal lacing let into the heel of the gate with a strong butment *, and secured from warping by the two upright lacings: the upper thimble being attached to or forming a part of a long bar or strap of iron of the same length as the gate, is fastened at the one end by a stout shouldering, and at the other by a screw nut, and the whole is put together with screws: by this plan the gate is not likely to sink at the head, neither is the top rail weakened with mortises, but greatly strengthened by the iron strap †.

Fig. 5 represents the lower hook and thimble and washer for a gate to open one way; the hook being furnished with a key-hole and cotter, which for a swing-gate should be attached to the other or upper hook. The

* The diagonal lacing ought not to be let into the gate quite so near to the lower extremity of the heel, as in the plate; but about even with the bottom bar.

† Oak posts of 10 inches square, or of a substance nearly equivalent thereto, with 3 or 3½ feet below ground, are suitable for such gates: the lower part of a tree of about 2 feet diameter will saw into 4 good gate posts with two flat sides to each, and a foot or upwards may be saved in the length, by making use of the but-end with particular advantage, which is commonly wasted.

upper

upper thimble for a common gate is made with a strap to pass through the heel, and fasten to the top rail of a gate with screws and a staple in the usual manner.

Fig. 6 is a catch adapted for the peg-latch and guard Fig. 7; but when used with the jointed latch represented on a reduced scale Fig. 4, it should have a button or stud in the place of the ring.

Fig. 10 * represents the double catch for a swing-gate; and the latch Fig. 4 is equally well calculated for a swing-gate, as for a gate to open one way †.

Fig. 11 is a hasp with a peg attached to itself, which was lately sent to me; the peg passes through the lower hole to fasten with a staple, and moves freely in the upper hole, but a stud prevents the peg being drawn quite out, or separated from the hasp.

In contriving hinges for a turnpike-gate, or any lodge gate, where a person is stationed to lock and unlock it; the principle recommended for a common gate to open one way may be thus applied: let the posts be placed edgewise as at Fig. 8, and the hooks as at Fig. 3, in the

* The catches are made too near to each other in the plate, so that the latch could hardly fasten itself between them: but specimens of all the iron-work have been presented to the "Board of Agriculture;" the "Society of Arts, Manufactures, and Commerce;" and the "Royal Institution."

† The fastenings for gates which are here recommended, are very readily opened either on foot or on horse-back, particularly with the jointed latches; at the same time that it is barely possible for cattle to open them: for fields where there are neither roads nor paths, it cannot be very material, what kinds of gates or iron-work may be adopted, so that a good fence is secured; nevertheless, in regard to road-gates, any means of counteracting the carelessness of passengers becomes very deserving of attention.

same

same vertical plane with the gate's line of fastening, which shall be also made its line of equilibrium; by attaching the proportionate extra length to the upper thimble instead of the lower one: this gate when fastened should be quite upright, but it will fall open to the right or left, and remain open by approaching its natural line of rest, which being thus reversed may be made in such cases to answer a very good purpose; particularly by the gate's continuing out of the way of carriages, until the person attending brings it upright again to its line of fastening.

Gates of an ornamental or fancy construction generally require strap hinges, and will sometimes be too heavy for the sudden check of the double catch Fig. 10: then the double hooks of the lower hinge Fig. 8 may be placed further asunder, which will add considerably to the fall of the gate; and there does not seem to be much use in a contrivance for preventing a heavy gate from being taken off the lower hinge, its weight being a sufficient security in that respect.

A notch, of a moderate depth and width, in a piece of iron makes a suitable catch for a gate of the last description, having sides gently to direct the latch up or down an inclined plane, so contrived as to admit of some vibration in the gate's swinging; which fastening is very common where the latch moves upwards: but I would recommend that the latch should move downwards, whereby it will be less liable to be out of order should the gate sink at the head; and the fittest form of a latch in such case, is like the lower or horizontal part of the jointed latch Fig. 4, and made to rest upon one of the bars of the gate, with the semi-circular handle also, but without any upright wire as at Fig. 4; avoiding every

kind of spring fastenings when they are to be constantly exposed to the weather. But there does not appear to be any objection to the latch with the upright wire as at Fig. 4, provided care is taken not to make the back part or handle of it too heavy; because in this fastening the catch is solid, and the fore part of the latch must sink and give place to the catch, while in the other instances the catches give way to the latches, as the gates fall and fasten themselves.

Having endeavoured to adapt these pages as well for the intelligent artificer, as for the scientifick reader; it may not be improper to add, that I have no sort of interest in the bargain which I have made for the publick with the blacksmith and carpenter, who have contrived tools for the expediting and improving of their work; which with the advantage of executing several orders together, induce them to hope for a continuance of the encouragement they have already experienced; that their goods can no where be matched at the same price *.

I shall

* Samuel Lawrence, Blacksmith, and William Bucknall, Joiner, Shifnal, Shropshire, will pay due attention to letters of orders post-paid, with ready money, at the under-mentioned prices; and gates for opening one way, as well as common iron-work, will be made all right-handed, like Figs. 2 and 4, unless the contrary be specified in the order:

	£.	s.	d.
Hangings and Fastenings for a common gate, - - - -	0	8	0
Ditto ditto, with jointed latch, - - - - -	0	10	2
The gate Fig. 4, with iron-work complete, - - - - - -	1	15	10
Ditto ditto, to swing, - - - - - - - - - - -	1	17	4
Wicket of any common dimensions to the pattern of Fig. 4,	1	2	0

Strap-

I shall conclude this article in the words of my pamphlet *, with the wish equally to avoid intruding an apology unnecessarily, as to appear insensible to the defects of this production: I must assure my readers, that either by their pointing out errors into which I have fallen, or by suggesting improvements that might add to, or even supersede these hints, I should consider myself most particularly obliged.

Hatton Grange,
16th *Oct.* 1802.

Scale of Plate III.

Fig. 4, half an inch to a foot.

Figs. 5, 6, 7, 9, 10, and 11, an inch to a foot.

	£.	s.	d.
Strap-hinges and heavy iron-work adapted to any ornamental gates (an exact out-lined drawing of the same being furnished) 8*d.* *per* lb.			
Box, packing, and booking for any order not exceeding 12*s.*	0	1	0
And for every additional shilling, - - - - - - - - - -	0	0	1

∴ Shifnal is only six miles from the river Severn, and twelve from the Staffordshire canal, by which means gates, &c. may be forwarded at a small expence of carriage to any part of the United Kingdom.

* Printed for Lackington, Allen, and Co. London, price 2*s.*

Method of rendering Whitewash made with Lime durable; also a Method of making a Composition to be used as a Substitute for drying Oils. By General Levavasseur.

From the Annales des Arts et Manufactures.

I AM enabled to certify the efficacy of marine salt in fixing whitewash made of lime. In the year 1795, when I was director of the naval artillery at the port of Toulon, I was commissioned to ascertain the utility of a method proposed by the master painter of that port, M. Maquilan, for whitewashing ships between decks, and likewise their holds, in a durable manner, by means of lime. Our report was in favour of this process, which consists in saturating the water in which the lime is slaked with muriate of soda. The whitewash produced by it is very permanent, does not crack, nor come off upon one's hands or clothes. The experiment was made only on wood. It appears, from M. St. Bernard's account, that it succeeded equally well on walls. The same worthy and learned man says, that this is not the case with M. Cadet de Vaux's whitewash, prepared with milk*: which many persons of my acquaintance, who have used it, have found not to answer, as humidity affects that composition very much.

I find in my notes the composition of a liquid mixture, invented in 1795 by the same Maquilan, as a substitute for drying oils, of which the port of Toulon was actually destitute at that period. As I was an eye-witness of the preparation and application of this mixture, I can answer for its success.

* Published in the 15th vol. of the first series of this work page 411.

Take

Take 16 lbs. of spirit of turpentine and 3 lbs. of tallow. First melt the tallow by itself; take the vessel from the fire, pour into it the spirit of turpentine, which must previously be warmed: put the vessel again on the fire, and, after boiling half an hour, proceed to a second operation.

Take 12 lbs. of spirit of turpentine and 12 lbs. of dry pitch and tar altogether into the second vessel, and set it on the fire. When the pitch and tar are dissolved, pour the solution into a third vessel together with the first solution of tallow and spirit of turpentine, which must be kept hot for that purpose: set the mixture again on the fire, and boil it for a quarter of an hour; this mixture is then used to grind the colours on marble, for a future supply.

A second solution of spirits and dry pitch and tar is prepared, and put by to dilute the colours ground and prepared as above, when they are wanted for use. Colours thus prepared, are equally applicable for wood or cloth.

Colours mixed up with this composition dry in less than four hours in the shade; but if exposed to the sun, they the following day discover a little viscosity, and stick to the fingers. However, this is only a temporary defect, for in four or five days the composition becomes so dry that the sun cannot afterwards soften it.

White-lead and minium cannot be used with this composition, because they become hard the moment you attempt to dilute them; this effect is not produced with ochres, nor with lamp-black.

I need not say that I do not communicate this as an economical process, but there may be occasions when the oils generally employed in painting cannot be procured; and it is then fortunate to have a substitute at hand.

It

It should be observed, that General Levavasseur is not the only one who complains of the whitewash prepared with milk. However, it is certain that M. Cadet de Vaux has himself used it at Franconville, and at other places; and we are inclined to think, that in describing the process he has forgot some circumstances that might probably appear of no consequence; some details which he imagined every one capable of supplying. It is well known, that the success of an experiment depends on the complete combination of all its component parts, and that the omission of even the most trifling quantity produces great errors in calculation.

Process for preparing Oxyd of Iron or Martial Ethiops. By M. Cavezzali, *Apothecary-General to the Civil Hospital of Lodi.*

From the Annales de Chimie.

THE oxyd of iron or martial ethiops used in medicine is prepared in various ways. The latest method is that of M. Fabroni, inserted in the 30th volume of the "Annales de Chimie." But they have all their disadvantages, and are more or less expensive.

M. Cavezzali has communicated a process which is both simple and economical. I have ascertained the results by repeating the experiment, and I think it preferable to all that have preceded it.

The process consists in mixing fifteen kilogrammes of pure iron filings with a sufficient quantity of water to make them of the consistence of dough. It is exposed to the

the air in a large vessel, and care is taken to renew it for a fortnight, in proportion as the water is decomposed or evaporated.

On the sixth day the mixture increases in volume and emits air-bubbles, the smell of which announces hydrogen, and which a lighted candle will set on fire. When this kind of fermentation has ceased (that is, on the sixteenth or seventeenth day), the mass is washed several times, to free it from the most subtle oxyd. This first washing produces 7 kilogrammes, 24 decagrammes, 5 grammes.

When the residue is dry, it is pulverized, and again washed, by which are obtained 9 kilogrammes of oxyd, less fine than the former. The remaining iron should again be mixed, and treated as at first. It at length becomes totally oxydated, and produces 4 kilogrammes and some grammes of oxyd. This augmentation of weight is therefore 5 kilogrammes, 24 decagrammes, and some grammes.

Spielman and Lemery have directed the iron to be treated with water, but I am convinced that too great a quantity of liquid is prejudicial to the operation, besides which, it renders it very long, and furnishes very little oxyd.

The reduction of the oxyd of brass or copper by fatty substances is inconvenient, on account of the vapour that is emitted, and the time it employs; and expensive on account of the oils, grease, and charcoal, it consumes.

According to M. Fabroni's process the iron is indeed covered with black oxyd; but it is not obtained in great quantity. This oxyd is always accompanied with a yellow oxyd, formed during the solution of the iron in nitric acid. The iron is super-oxygenated at the expense of

of the water or nitric acid, and is instantly precipitated without forming yellow oxyd.

The following points will be necessary to be attended to: 1. That the water used must be very pure: that if spring water be employed, it ought to be distilled, because it always contains a greater or smaller quantity of salts with earthy bases.

2. The water should not exceed the iron in quantity, nor cover it, because then the oxydation would take place only on the surface.

3. The mass should be frequently stirred, that the action of the water may equally affect every part of the iron.

4. Summer is most favourable to this operation, because then the water is most easily decomposed.

5. At the moment when the iron seizes upon the oxygen of the water, it frees itself from the caloric.

Experiments on the Action of some newly-discovered Metals and Earths on the Colouring Matter of Cochineal.

By M. HERMBSTADT.

From SCHERER'S JOURNAL DER CHEMIE.

IN order to prepare the cochineal for these experiments, I took two ounces of Mexican cochineal, of the best quality, reduced it to a fine powder, and boiled in a tin pot, for 15 minutes with 74 ounces of distilled water. This liquor I afterwards filtered through paper and weighed; it had lost 2 ounces by evaporation. For each experiment it was divided into portions of 2½ oz. each.

A piece of casimir plunged into this dye came out of a laylock colour.

Experiment

Experiment I. To a portion of the cochineal dye, I added a saturated solution of very pure cobalt in nitric acid. The dye became extremely clear, assumed a yellowish red colour, but remained transparent. In the space of twelve hours it deposited a red precipitate of sulphur, which was however in such small quantity that it was impossible to collect it.

Experiment II. I diluted part of the solution of cobalt in nitric acid with water, heated to ebullition in a glass vessel, and kept boiling 3 minutes, with a piece of casimir 24 inches square. The casimir, thus prepared, was plunged into the cochineal dye hot; it instantly assumed a dark red colour, leaving the dye colourless. The stuff, after being washed and dried, preserved a bright purple colour.

Experiment III. To the cochineal liquor I added a neutral solution of cobalt in sulphuric acid; the dye instantly became darker and deposited a violet precipitate. A piece of stuff, being impregnated with this solution and then plunged into the hot cochineal liquor, immediately assumed a deep violet colour.

Experiment IV. A neutral solution of pure oxyd of uranus gave, with the cochineal liquor, an almost black precipitate. But a piece of stuff being soaked in the solution of uranus and then dyed in the cochineal liquor, it acquired a very agreeable grey colour, inclining to green.

Experiment V. A neutral mixture of nitric acid and oxyd of uranus, treated in the manner just described, produced the same result, only the colour of the stuff was rather more lively.

Experiment VI. I put 15 grains of pure concrete tungstic acid into a glass vessel, with 6 ounces of distilled water, and boiled the liquid down to 4 ounces. It assumed a turbid appearance, and a colour shifting from white

to blue. Some of this liquid, being poured into the cochineal dye, communicated a clear violet colour to it. I then boiled a piece of casimir in this liquid for 3 minutes, and it assumed in the hot cochineal liquor a lively red poppy.

Experiment VII. In the manner mentioned above, 15 grains of concrete molybdic acid, with 6 ounces of distilled water, were boiled down to 4 ounces. The molybdic acid was completely dissolved, and the liquid was clear and transparent. When dropped into the cochineal dye, it produced a dark violet precipitate. A piece of white casimir being boiled in the acid solution acquired a greenish colour, which, by the drying of the stuff in the sun, turned to a grey approaching to a light blue. I put a piece of casimir, prepared with the molybdic acid, into the hot cochineal liquor, and obtained a very agreeable violet colour.

Experiment VIII. I mixed arsenic acid with the cochineal dye. Its dark red colour was converted into a yellowish red, without however forming any deposit. I then boiled a piece of casimir in a very weak solution of the same acid, and plunged the stuff, thus prepared, into the hot cochineal liquor. It instantly assumed a bright scarlet colour, approaching very nearly to yellow. In drying, but particularly in being pressed under a hot iron, this colour lost part of its liveliness, and became darker.

Experiment IX. Upon another piece of casimir I employed a solution of arseniate of soda, slightly acidulated, and, by immersion in the cochineal dye, I obtained a dark purple.

Experiment X. The same experiment was repeated with alkaline arseniate of soda. It formed an agreeable aylock.

Experiment

Experiment XI. Common white arsenic dissolved in pure water, and employed as a mordant, produced a darker laylock.

Although my original intention was only to examine the newly-discovered metals, yet the results I had before obtained with lead as a medium for fixing the pigment of cochineal induced me to submit it to further investigation. At the same time I undertook an examination to ascertain how far the employment of nitrate of tin is indispensable for common scarlet, and whether muriate of soda may be substituted in its stead.

Experiment XII. I poured a solution of acetite of lead in the cochineal dye: it instantly produced a violet-blue precipitate. I afterwards plunged in the same dye a piece of casimir, prepared with the acetite of lead, and obtained a very agreeable violet colour.

Experiment XIII. I prepared a solution of fine English tin in pure muriatic acid, and exposed it for four weeks in an open vessel to the action of the air. I boiled a piece of casimir in this solution, and then removed it into the hot cochineal dye, where it assumed a bright scarlet colour.

The result of this experiment, in my opinion, deserves the greater attention, as it has hitherto always been imagined that, without a solution of tin in aqua regia, it was impossible to produce a scarlet dye. If nothing but common muriate of tin is employed, a scarlet cannot indeed be obtained, but a red, inclining to violet. Hence the oxygen in the nitric acid appears to be the agent that enlivens the colour. But as the latter is abundantly absorbed from the atmosphere by the solution of muriate of tin, the expense of that acid, and of sal ammoniac, for this colour, may be dispensed with, and muriatic acid, which is far cheaper, may be substituted in their stead.

Experiment XIV. I boiled a piece of casimir in a neutral solution of muriate of barytes for three minutes, and then plunged it in the hot cochineal liquor. The stuff acquired a very dark colour, aud, after being washed and dried, turned to a very agreeable violet.

Experiment XV. Nitrate of barytes, employed as a mordant, gave an extremely agreeable poppy-red.

Experiment XVI. Acetite of barytes, employed in like manner as a mordant, gave a poppy-red, rather darker, but possessing much vivacity

Experiment XVII. I put a piece of casimir for three minutes in a neutral solution of muriate of strontian, and then into the cochineal liquor. It assumed a dark colour at first resembling scarlet, but which in drying turned to crimson.

Experiment XVIII. A neutral solution of nitrate of strontian, employed as a mordant, produced in the cochineal liquor a lively red-brown.

Experiment XIX. Acetite of strontian gave a lively poppy colour.

The results of these experiments prove not only that the metals and earths employed in them possess a certain chemical affinity with the colouring matter of cochineal, and are capable of fixing it on stuffs, but, likewise that they possess the property of producing very different tints with the same pigment. On the other hand, experience shews that the acid which is used to dissolve these substances has a great influence in the production of the particular colour. This is proved by the tints from cobalt with nitric and sulphuric acid, as well as the various shades produced by barytes and strontian, when combined with the different kinds of acids.

The results obtained with arsenic and its acids are not less remarkable. The difference in the tints produced by

by both is particularly striking. The various proportions of oxygen in them appears to be the only efficient cause of those phænomena; and this may likewise be perceived in the results from the muriate of oxydated tin.

Description of a new Process of Refining.

By M. DARCET.

From the JOURNAL DE PHYSIQUE.

IF the practice only of an art is sufficient to give it a tendency towards perfection, it must likewise be admitted that the numerous uses in which its productions are employed, the numerous manufactories in which its processes are performed, are the principal causes that contribute towards its more speedy arrival at this desired point; indeed, if the articles fabricated are of general utility; if the processes are universallv employed, a competition takes place, and the manufacturer then tries every method of ensuring victory in the struggle in which he is engaged. It is then that private interest simplifies, brings to perfection the operations of art, and succeeds in affording, at a lower price, productions equal, frequently superior, to those obtained by the original processes; and it is thus that we see a multitude of arts daily attaining a great degree of perfection. I might here instance the art of pin-making, needle-making, &c. &c.; but, it is my intention to describe a new process of refining *; and the subsequent details will confirm what I advance.

* I here consider refining only as an art; and not under the connection which its practice may have with the financial operations of a state.

It

It is well known, that in commerce articles of gold and silver, after being long used, from an alteration in fashion, or other circumstances, are again melted together and combined, without following any other principle than what is founded on the fluctuating market for these commodities.

The produce of these combinations must, therefore, consist, at first, of different proportions of gold and silver; but, afterwards, such metals as may lawfully be alloyed with those materials, in order to be employed in jewellery, and goldsmith's work.

These metallic alloys, to return into circulation, that is, to be again converted into articles of gold and silver, must undergo an operation which brings them to the quality fixed by the law; there are two methods of attaining this aim.

The first, and the most natural, is that which indicates the additional quantity of gold, silver, or copper, necessary for producing the established proportions of the alloy.

By the second, all the metals are separated from each other; and, after having reduced them to the state of pure, simple bodies, the operator proceeds to alloy them in the lawful proportions; but the first of these processes is comprehended in the second; since, in the latter, the materials purified by the former are employed; and, it is obvious, that the final object is only the separation of the constituent principles of an alloy of gold, silver, &c.

This operation is termed refining.

The operations of refining are all founded on the particular properties of the bodies on which the refiner has to operate. The principal of these manipulations is that of separation: it is grounded on the indissolubility of gold in nitric acid; which, by dissolving the silver, copper, &c. conseq .ently leaves the gold, that was combined with those

those metals, at the bottom of the vessels in which the dissolution is performed.

This was the result of a single experiment; but practice soon occasioned it to be remarked, that, in order to produce this dissolution, the alloy should consist of one part of gold and four parts of silver; and that it was the more perfect, the greater quantity of concentrated acid was employed, and the more intense the heat applied to the vessels. These observations perfected the art; but yet did not enable the operator to produce gold of the highest degree of purity, as the metal from the crucible never exceeded 998, or 999.

In this state I found the art upon my introduction into the national refinery; and, a kind of competition subsisting between me and the refiners in trade, I assiduously endeavoured to bring to perfection the processes already in use; and I here present to the arts that which has invariably been crowned with success, during a period of two years.

I shall begin with describing the former process of refining; and shall, afterwards, explain the method which I substituted in its stead.

The refiners receive in trade ingots more or less pure, but usually of a quality between ,850 and ,950; they mix and combine these ingots by fusion, in such a manner that the alloy produced by them may contain 4 parts of silver for one of gold: they run off these alloys into grains like shot; and to every 5 kilogrammes, 500 grammes, they add 650 grammes of nitrate of pot-ash *.

* The intention of this operation is to oxydate the copper and other metals, existing in the alloy of gold and silver; and after this fusion its quality is ,978, which greatly diminishes the quantity of acid that would have been required to dissolve the whole of the alloy.

This

This mixture is then melted in crucibles, in which it is left to cool in lumps; these are again melted, and are run off in grains, that the alloy may present a greater surface to the nitric acid employed for the separation.

The refiner, in order to perform this operation, distributes the grains into several vessels, pouring two parts of nitric acid, of 30 degrees, to one part of this alloy: he removes the pot to a sand-bath, and thus, by means of heat, facilitates the action of the nitric acid on the silver: when the dissolution is completed, he decants the nitrate of silver, and washes the gold, till the water from it ceases to decompose muriate of soda.

The gold is still not disengaged from all alloy; he therefore adds to it nitric acid, at the same degree as before, heats the mixture to ebullition, decants the nitrate of silver, washes the gold, and adds to it nitric acid of 40 degrees: he again removes the pot to the sand bath, and after boiling a considerable time he separates the gold from the acid, washes the metal very carefully, dries it with a moderate heat, melts it and runs it off in ingots, the quality of which, as I mentioned before, does not usually exceed ,998, and is frequently below ,995, the limit fixed by the law. In the latter case, the refiner is obliged to repeat the process of purification and separation; his expenses are therefore doubled, and, perhaps, even tripled, if in the second operation he does not prevent a repetition of the circumstances which rendered the first unsuccessful.

It is this part of refining to which I have given the most perfection, as will be seen by the description of my process.

I mix the ingots as in the old operation, in such a manner, that when melted together the gold contained in this alloy is, in proportion to the silver, as 1 to 4. I melt

I melt the ingots of this composition; and, when the matter is perfectly liquid, I throw into it about 200 grammes of nitrate of pot-ash, to 20 kilogrammes of this alloy: this small quantity of saltpetre is sufficient, as I have remarked, to oxydate the tin, which the ingots of trade always contain, in a greater or less proportion. It is essential to separate this tin from them, because, in the operation for that purpose, it would be oxydated, mixed with the gold, and, perhaps, previous to the fusion, might be partly reduced, render that metal brittle, and lower its quality.

When the whole is in perfect fusion, I immediately run it off in grains; which I distribute into pots, as in the old operation: I add to it the same quantity of nitric acid, of the same degree, and employ exactly the same manipulations, as those above described; in short, I follow the old process till the moment in which the gold, after being well washed, is put into the crucible. I unite this gold, when well washed, in as few vessels as possible, and I add to it as much sulphuric acid, at 66 degrees, as will cover the surface. I raise the temperature of the acid by placing my vessels on the sand-bath, I increase it to ebullition, and keep it about an hour in that state; I afterwards let the whole grow cold *: I decant the acid, and I wash the gold, till the waters from washing cease to afford a precipitate by the addition of the mu-

* I must observe, that it is essential to suffer the sulphuric acid which has been boiled with gold to become perfectly cold before it is decanted; otherwise, the vessels employed would be unable to resist the intensity of the heat which the acid acquires in ebullition; and the operator would be in danger from the flying of the vessel, and the drops of acid which would be thrown out on every side. For greater security, the bottom of the pan might be covered with sulphuric acid, of 66 degrees, at the temperature of the atmosphere.

 riatic

riatic acid and alkalis. Nothing then remains to be done but to dry the gold, which is in powder, and to reduce it to ingots, which are invariably equal in quality to 1,000 or 24 carats.

These are all the details necessary for a guide in the practice of the operation which I propose: the following are the advantages which I attribute to it.

Besides the saving in charcoal, and crucibles, fewer manipulations are required: but the principal advantage of this improvement is the great diminution of residuum; for in the old method, the great quantity of nitrate of pot-ash that was added, promoted the oxydation, or extreme division, of a large quantity of silver, which then remained in the scoria, with the oxyd of copper, the pot-ash, &c.; and this loss amounted, in each operation, to 2400 grammes of silver, of the quality of ,350 to ,400; and this silver frequently remained for years without producing any profit; that is, till the refiner had a sufficient quantity of washings to make it worth his while to melt it.

I have before mentioned, that I always obtain gold at the highest degree of purity, or at 1,000: which is obviously a great advantage to trade; but, it is a much greater to the refiner, who is sure of the result of his operation; and who, if accurate in his calculations, no longer runs any risk of being ruined by the failure of his operations, and the necessity of several times repeating a process, of the success of which nothing can afford him a certainty.

Transactions of Societies for promoting useful Knowledge.

Society of Sciences of Harlem.

THE Society of Sciences of Harlem will receive memoirs in answer to the three following questions till the 1st of November 1803:

1. What is demonstrated by the most recent experiments relative to the alteration in colour effected by the oxygen, contained in atmospheric air, either when assisted by the action of light or not, and what useful consequences may be derived from them?

2. What information can we obtain from the decomposition of water and atmospheric air in relation to the manner in which plants receive nourishment, and what consequences may be drawn from it, for the improvement of useful vegetables?

3. What do we know from experience of the purification of water and other impure substances by means of charcoal? How is that fact explained by chemistry, and to what useful purposes may it be applied?

The same society has prolonged indefinitely the term fixed for answering the three questions before proposed, on the utility to be derived from animals apparently pernicious; on the employment of indigenous plants not hitherto used in medicine; and on such vegetables as might furnish a solid and wholesome nutriment, and which no method has been discovered of employing for that purpose.

Academy of Arts, Sciences, and Belles Lettres, of Dijon.

At the public meeting held 19 Fructidor (6 September), M. Leschevin read a report of the discovery of the phenomenon

menon of the scintillation of a piece of charcoal by striking against another piece.—This discovery will form an epoch in natural history. The report itself must be consulted for the detail of the experiments which prove this phenomenon in the most incontestible manner. He has confirmed the suspicions before entertained of the danger of employing charcoal in sticks in the manufacture of gunpowder, and has proved the necessity of adding another precaution to those already observed in making that article, namely to use no charcoal but in a pulverized state.

M. Montigny has addressed to the academy a memoir on the art of writing as expeditiously as a person can speak. The author combines in his method the advantages of tachigraphy and stenography, which may be of considerable advantage in certain cases.

M. Potel, in a memoir on bleaching, communicated to the society some very interesting details on the new method substituted instead of the old, for bleaching cloth: he then examines the different agents employed for that purpose within these few years, and points out those that are to be preferred; as odorated oxygenated muriatic acid, caustic alkalies in vapors, which he himself employs in his establishment. He demonstrates that the use of calcareous sulphur without mixture is highly improper for bleaching: he explains how unfounded are the apprehensions of those who reject the new process, because, say they, it burns the cloth; he removes every doubt, and proves that if the operation is performed by an intelligent and careful artist, the cloth gains instead of losing; that, as a farther advantage, it is fit for use in a fortnight, whilst the bleaching in the fields requires 15 months to be completed.

The practice of using oxygenated muriatic gas led M. Potel, by accident, to various trials and experiments of the

the greatest importance. He has discovered that this substance may be employed with the greatest advantage in all cases of suddenly suspended pulsation and respiration. This memoir contained many curious facts and interesting details, and particularly an attempt which proves how far a man may carry the love of science. The author tried the efficacy of his new remedy on himself, and success crowned his courage.

M. Degouvenain communicated the results of a great number of experiments made by him on acetous fermentation. Convinced that the strength of aromatic vinegar depends much more on its acid nature than on aromatics, he has made a kind which requires from 130 to 150 parts of potash to 1000 to be saturated, whilst the strongest sorts before known absorb only 114.

Good wines combined with oxygen by a series of ingenious processes, peculiar to himself, are the only substances he employs; and from these he produces vinegar, which, according to the report of the commission appointed by the academy to examine it, is superior in every respect to the most celebrated kinds hitherto made.

M. Dubois presented to the academy the model of a machine for cutting files; and the plan of a forge for the fabrication of steel, and cabinet makers' tools.

Thus manufactures formed the subject of the labours of the academy, convinced that one of the sources of the prosperity of the state depends on the activity of commerce, and the perfection of manufactures: and it was determined, that a repository of the productions of nature and industry in the department should be established. The academy hopes by this measure to hold out encouragement to industry, and to ascertain the annual improvement by the comparison of the successive productions that will be transmitted to it.

No:

No memoir having been received on the question on child-bed fevers, proposed at the public meeting 20 Messidor, year 8 (9 July 1800), the academy consequently withdrew the prize.

The following is the subject of the question proposed for the next prize:

"Catarrhal fevers become more frequent than they ever were before: inflammatory fevers grow extremely rare; bilious fevers are less common. To determine what are the causes that may have effected these alterations in the climate and in the human constitution."

The prize, value 500 francs, will be adjudged at the public meeting in the month of Fructidor year 12 (August and September 1804.)

Society of Sciences, Belles Lettres, and Arts of Bordeaux.

The interest of commerce as well as of agriculturists renders this society desirous of ascertaining the characters by which the staves, liable to communicate to liquors the taste of the cask, may be distinguished. It has even entertained a hope that some fortunate experiments might lead to the discovery of some method of taking away from wine the disagreeable taste it contracts in vessels faulty in that particular. These motives induced it to accept the generous offer made by one of its members, M. Bergeron, of the sum of 300 francs, for a prize to be adjudged in Germinal year 11 (March 1803) to the person who shall transmit the best solution of the two following questions:

What is the most simple and easy method of discovering and distinguishing the staves that are liable to communicate to wine the taste of the cask?

What is the best process to be employed for taking away entirely from wine the taste of the cask, which it has contracted?

The

The time for the reception of memoirs is now prolonged to the 30 Prairial year 11 (19 June 1803); and the prize will be decreed in the month of Fructidor, (August and September.)

The naturalization in France of the Spanish breed of sheep, called Merinos, is the most important step that has of late been taken towards the improvement of the pastoral art: it may in a few years triple the ordinary produce of the flocks on the same extent of ground. Such great advantages should cause this useful innovation to be adopted with ardour; but the difficulty of procuring these precious animals, and especially the blind routine of the too numerous agriculturists who are averse to reading, has retarded the introduction of the breed of Merinos. The society thought a year ago that it might be beneficial to offer a premium to be adjudged in the course of the year 11 (1803) to the farmer in the department of the Gironde, who should most contribute to the improvement of the breeds of sheep, by his exertions, his industry, and the introduction of Merino rams upon his lands.

The society has ascertained, from accurate information, that the breed of sheep with superfine wool has not been sufficiently multiplied in the department, to establish a useful emulation amongst the possessors: but it has learned with satisfaction, that a flock of 100 animals of that breed has lately arrived, and has been distributed amongst several farmers; these two circumstances have determined the society to postpone to the public meeting in Fructidor (August and September) the delivery of this premium, which is to be of the value of 300 francs. The competitors are to transmit to the society, before 1 Messidor year 12 (20 June 1804), samples of the wool from their rams and ewes, and a report from the mayor of the place relative to the state of the flock.

List

List of Patents for Inventions, &c.

(Continued from Volume I. Page 480.)

WILLIAM FORDER, of Portsea, Hants, Purser in his Majesty's Navy; for a diving machine, to be used about shipping and in stopping holes and leaks in ships bottoms, and for other purposes. Dated October 2, 1802.

JOHN GRIMSHAW, of Bishop Wearmouth, Durham, Rope-maker, being one of the People called Quakers; for improvements in machinery for laying ropes. Dated October 5, 1802.

JOSEPH BRAMAH, of Pimlico, Middlesex, Engineer; for a machine for the purpose of producing straight, smooth, and parallel surfaces, on wood, and other materials. Dated October 30, 1802.

AUGUSTUS FREDERICK THOELDEN, of St. Alban's Street, Pall-Mall, Middlesex, Esquire; for a mechanical apparatus for supporting the human body. Dated October 30, 1802.

JAMES SMETHURST, of St. Margaret's Hill, Southwark, Surry, Lamp Manufacturer, and NICHOLAS PAUL, of Villiers Street, Strand, Middlesex, mechanician; for improvements in lamps and reflectors. Dated October 30, 1802.

JAMES HOW, of Bovingdon, near Hemel Hempsted, Herts, Farmer; for a plough upon an improved construction. Dated October 30, 1802.

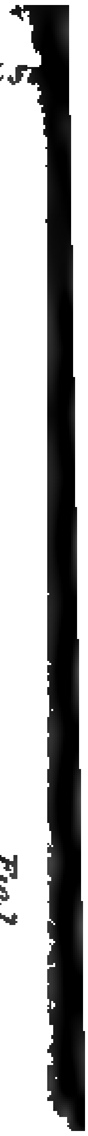


Fig. 1

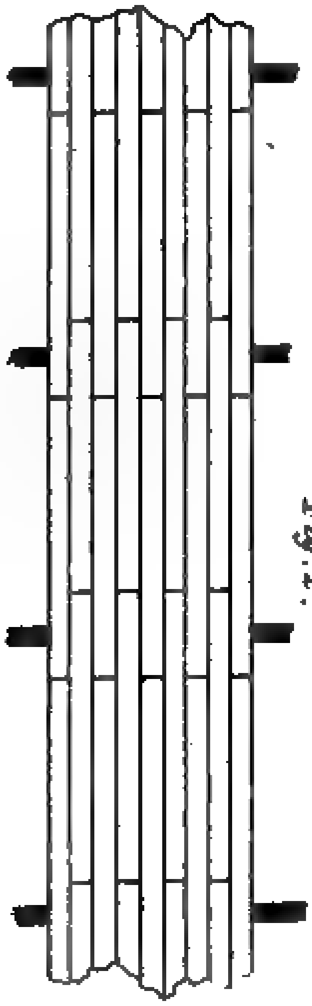


Fig. 2.

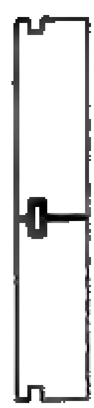


Fig. 6.

Fig. 4

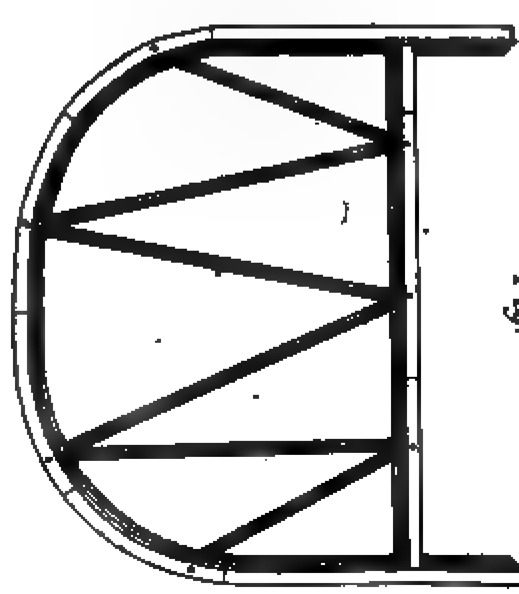


Fig.

THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

NUMBER VIII. SECOND SERIES. JAN. 1, 1803.

Specification of the Patent granted to JOHN WHITLEY BOSWELL, *of the City of Dublin, Gentleman; for his Method of building or fabricating Ships or Vessels for Navigation.* Dated May 20, 1802.

With a Plate.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said John Whitley Boswell do hereby declare my invention to be described in manner following; that is to say: My new method of building or constructing vessels for navigation differs principally from the old method in the placing timbers or ribs lengthwise or horizontally instead of vertically, by the means hereinafter recited; and in using a framing, consisting of a series of triangles, hereafter described, in such parts of the vessel, and in such cases, as are there mentioned, either to produce a greater strength with the same quantity of materials, or an equal strength for a smaller quantity. By

which it is expected much less crooked timber need be used than is now employed, and the danger of using pieces cut across the grain proportionally diminished.

The said new method of building vessels for navigation is contained in the following directions for constructing a vessel in this manner.

First, having determined on the size and shape of the vessel intended to be built, it is to be supposed to be divided by transverse vertical sections at right angles to the keel, at certain distances from each other, (see longitudinal section, Fig. 1, Plate IV.) which distances must depend chiefly on the strength of the materials to be used in constructing the vessel, requiring to be less when the materials are slighter, and admitting of a greater extent when the materials are stronger; therefore there will be fewer of those sections required in the latter case than in the first, but in general they should not be fewer than four. Secondly, having ascertained the number and places of those sections, a frame must be made of the shape of each section externally, so that the upper part of it may be of the breadth of that part of the deck under which it is to stand, and its sides and bottom may be moulded according to the true shape of the sides and bottom of said section; the more particular construction of which said frames is to be described hereafter. Thirdly, when said frames are formed, each of them is to be erected in the place corresponding to the section of that part of the vessel it is meant to represent as aforesaid, and to be there supported by temporary props or stays, so that the workmen may get at every part of them; the stem-post and stern-post also to be erected in like manner in their proper places. Fourthly, timbers or ribs are then to be laid horizontally from frame to frame, at their outward surfaces, extending from stem-post to stern-post, and to be

be fastened to the frames and posts by bolts or otherwise; which horizontal ribs are each to be moulded according to the shape of that part of the vessel where it is to lie, and to be of that thickness which the size of the vessel, and the distance of said transverse frames from each other may require, so as to produce sufficient strength. These horizontal ribs are each to be fayed at its extremity into the next which joins it at either end, are to have those junctures near to the frames, and to extend in at least every second case, with a single piece of timber, a foot or two beyond the two frames to which it is to be fastened; and where timbers can be got to extend to three or more frames, they are to be preferred, see Fig. 2, which represents a part of the side of the vessel so constructed. If it should be thought fit to place the said horizontal ribs so that intervals should be between them, a method should be followed in building which will be described more at large hereafter; but should they be placed as close to each other as it is usual to place the vertical ribs in the common method of building, then the next operation should be to fasten planking to them, outside and inside, with treenels or otherwise, at right angles, to the direction of the ribs, or vertically; and if any inconvenience should arise or be apprehended from the vertical position of the outside plank, a sheathing of board may be fastened over it in the usual manner. Wherever the curvature of the bottom of the vessel will admit it, the outside planking should be made to pass between the bottom ribs and the keel; and where the shape will not admit of this, (as near the stern,) I recommend that the inside planks be put on first after the ribs, and their lower extremities made fast to the kelson, or a piece to be for this purpose bolted to the keel inside; and that

the outside planks be rabbetted, and firmly fastened to the keel, as much below this as will give them a firm gripe in the keel. It will facilitate this last operation if two or three of the said hotizontal ribs, next the stern, close to the keel, are not fastened up finally till the inside planks are fastened at the bottom in this part as here directed.

Of forming the Head and Stern.

In forming the head, where the curvature approaches near to a circular form at the stem-post, the horizontal ribs may there be joined to curved pieces, like breast-hooks, bolted to the stem-post; and where the angle required is too sharp to admit of this, they may be bolted, or otherwise fastened, to the stem-post, and may be farther secured, if necessary, to an internal piece, to run in the direction of the stem-post, and be well fastened to it. These last directions will also apply to the formation of the stern.

Of the Keel and Kelson.

The keel should either be put on after the outside planking was laid in all parts of the bottom, where the curvature was not too great, over the place of the keel; or, if the keel is desired to be first laid down, the horizontal ribs should be supported in such a manner above it, by pieces of wood, to be afterwards removed, as to admit the part of the planking, before directed to be passed between them and the keel.

The kelson should be placed along over the inside plank, in all parts where it will admit of being so, and be bolted down through it and the horizontal ribs, directly underneath to the keel.

Farther

Farther Description of the transverse Frames.

The transverse vertical frames (before described as to their external shape only) should be formed thus: their sides and bottoms should be made of pieces sided and moulded like the vertical ribs, in the common method of building ships, in that part of the vessel they are intended to stand; more than three series of timbers, side by side, will be unnecessary to form them, and not less than two should be used: in either case, the joints endwise of one series should be arranged so as not to be opposite the joints of another series in the same frame. The part under the deck should be formed of straight beams, or of beams of the small curvature, usually given to the deck. The different series of pieces in the same frame should be fastened sidewise to each other by bolts or trennels. And farther, to strengthen said frames, and by them give great strength to the whole ship, I direct that pieces be passed obliquely from the horizontal beams of said frames under the deck to the sides and bottom of said frames, so as to divide the whole of the internal space or plane of the frames into triangles. Which last I recommend, because I have found that in a triangular frame any strain at or near the angle spends its force in tending to rend asunder the piece opposite in the direction of its fibres, or lengthwise, in which direction it can bear a much greater strain than across the grain; and that, in a frame formed of a number of triangles, no strain can be given to it in the direction of its plane, which will not fall either directly or indirectly in one or more angles, and thereby have the effect already mentioned. These oblique pieces may be let into the substance of the frames, and be fastened by bolts passing through the frames and them, and may be farther secured by iron bands

bands or iron straps, if judged necessary, to the sides and top of the frame. The sides of the frames should be made to extend a foot or two above the deck beams for small vessels, and a greater height for large, for the convenience of forming the parts of the sides of the vessel at and above the deck. One of those frames, as intended for the midship-frame, is drawn in Fig. 8.

To build with Intervals between the horizontal Ribs.

When it is desired to leave intervals between the horizontal ribs, the method of proceeding should be as follows. It is best that two ribs should be brought all along close together at the side of each interval, for the better strengthening of the junctures at their extremities. Having fixed on the intervals to be left between any two pair of ribs, let said ribs be formed or moulded at least so much thicker, from in to out, than would have been necessary had they lain close together, that the square of their whole thickness may be equal to the sum of the thickness of as many ribs, (each of the same breadth sidewise as the said pair,) as would fill up said interval, added to their own breadth. Then diagonal pieces should be placed across each interval, from the side of each transverse frame to that of the next, to which they should be fastened so as to form the whole surface into a series of triangles, (the advantage of which has been already shewn,) after which planking should be laid on across the direction of said ribs, or vertically, of sufficient strength to bear the pressure of water between each two pair of ribs, at the depth beneath the surface of the water, where it is to lie. Outside of which there should be placed a second coat of planking in the direction of the ribs, or across the direction of the first, to prevent the danger which might arise of the oakum

working

working out from the seams of the first planking, on account of the great distance that must be between the trennels in many parts in this last method of building. A part of the side of a vessel, formed in the manner last described, before the planks are put on, is represented in Fig. 4.

Of forming the Decks.

The decks of vessels, built on this my new method, should be formed in somewhat a similar manner to this last described for the sides, that is to say; beams or pieces of timber, similar to the ribs, should be laid lengthwise over the upper part of the transverse frames, and fastened to them, with intervals between each pair, across which intervals other pieces should be laid diagonally from frame to frame, and fastened with trennels, or otherwise, to said frames. Smaller pieces should then be either placed across the direction of the beams, and let into the substance thereof, over which the planking should be laid lengthwise; or else the smaller pieces should be laid in the direction of the beams, from frame to frame, over, or let into, the diagonal pieces, across which the planking should be laid at right angles, to the direction of the beams; and this last method I prefer, as it gives an opportunity of dovetailing, or otherwise fastening, the ends of the planks to pieces, to be well fastenened for that purpose to the sides of the vessel, from frame to frame, horizontally under the deck; by which it is conceived the sides would be united more firmly to the deck. I would also recommend, that the upper cross parts of the frames be let an inch or two into the substance of said longitudinal beams. When a vessel is required to be built of so large a size that it will require plank of such a great thickness as could not be bent in a vertical

vertical position without a degree of labour and expense which would too much counterbalance the advantage of leaving out vertical ribs altogether; then, in this case, I direct that the horizontal ribs may have large intervals left between them, and be made so much thicker from in to out as the directions before given for building with intervals between the horizontal ribs would require them to be; that then the diagonal pieces are to be firmly fixed in the manner and position before directed; after which I direct that small vertical ribs be fastened over the horizontal ribs, with such intervals between them as their thickness, and the thickness of the plank to be used, will allow; over which vertical ribs the planking is to be made fast with trennels, or otherwise horizontally, or fore and aft, in the usual position and manner; and this last method of building may be farther strengthened, if thought fit, by fastening diagonal pieces between the vertical ribs also in a similar manner to that already herein directed for those to be used with the horizontal ribs.

It is my intent, that every part and thing of and about the vessel not described here should be made or done according to the method in general use for doing such things, or forming such parts; and that knees and beams across under the deck may be put in if thought proper, and hanging knees and riders, though at present I do not think them necessary; and that the principle of building here described may be extended to build vessels with two or more decks, and is applicable to the building of all vessels, from a boat to a first-rate man of war. It is necessary to mention, that though I do not recommend it, the transverse frames herein recited may be also used in building ships (if of a smaller size) to support horizontal ribs, without being divided into triangles, and without having any strengthening pins passing across their

their planes, but merely consisting of external frames, of the shapes of the different sections of the vessel, as before mentioned, and that they wholly or partly may be made of cast or wrought iron, if it is preferred by other builders to do so.

The advantages which I expect this method of building ships will have above that in common use, are, first, that it will produce great additional strength by the transverse frames and the horizontal ribs; the first from the great power given them by the triangular frames; and the second by giving their power of support in the direction where the greatest strain is, or lengthwise; by which it is conceived vessels so built will be entirely prevented from hogging (as it is termed), or having broken backs. Secondly, a vast proportion of crooked timber may be saved, which, for large vessels particularly, is much more difficult to be procured than the straight, as, by the horizontal position of the ribs, in most parts straight timber, or timber nearly straight, may be used for their formation, except at the head and stern, by which also the use of timber cut across the grain may be proportionally diminished. Thirdly, much knee-timber may be saved, which the triangular framing of the decks will render unnecessary. And, fourthly, when the method described of building ships, with the intervals between the horizontal ribs, is used, it is conceived a great quantity of timber of all kinds, both straight and crooked, may be saved without diminishing the strength or security of vessels so built. Fifthly, even in the last method of building directed, it is conceived there will be a considerable saving of crooked timber, as the vertical ribs in this method, having so many points of support from the horizontal timbers, may be formed of a much less

 size

size and length, and have larger intervals left between them, than could be used in the common method of building, to produce the strength required; and, it is conceived, there may be also a saving in the planking, as, in this method, it is imagined no inside planking need be used, but only a boarding nailed on, sufficient to keep the cargo or ballast from resting on the outside planking in the intervals between the ribs, by which it is conceived the farther advantage of facilitating repairs will arise, as by ripping off the said boarding a damaged rib might be removed, and another inserted, without removing the outside plank, or any other part of the frame. Although I have described above those methods which appear to me the best calculated for carrying the principle of my invention into practice, yet minute alterations, arising from the different methods and proficiencies of workmen, will not materially affect the manufacture, if the directions contained in the specification are followed; as they fully disclose the end and principles of the discovery. And, lastly, as much damage happens to vessels from the insufficiency of the present method of closing the seams between the planks, it is proposed, as a farther security to any of the above methods of building, that, if it is thought fit the planks may be grooved at their edges, so as when said planks are put together, the grooves may be opposite each other; and that narrow slips of durable wood be placed in said grooves, so as to lie across the seams the whole length of the planks; the size of the grooves and planks must depend upon the thickness of the planks used, and must be placed so as to leave sufficient space outside them for caulking; and it would be best perhaps to make the slips of less breadth than the grooves, so as to permit their being pressed in-

ward.

ward. It is imagined these slips will have the effect of valves to prevent the farther progress of any water that passes the oakum, tending to close the passage more tightly the more they are pressed by the external water. The ends of two planks so grooved, and of the slip between them, are represented in Fig. 5.

In witness whereof, &c.

Specification of the Patent granted to WILLIAM CHAPMAN, *of Newcastle-upon-Tyne, Gentleman, for the Application of certain Substances, either separately or combined, as a Preservative of Cordage.*

Dated June 5, 1801.

TO all to whom these presents shall come, &c. NOW KNOW YE, that the principal substance of those which I have invented the application of to cordage, is any resinous matter whatever, deprived of its mucilage and superabundant acid, either wholly or in part, and as the cheapest of all the resinous matter is tar, I shall explain the application of them by having reference to it. Tar, whether in its original or in its more inspissated state, in which it is applied to cordage, (by the white yarns being passed through it and the superfluous quantity expressed,) contains a considerable portion of mucilage, which causes the tar, with which the ropes are impregnated, to be dissolved in that fluid against which it is intended to preserve them. Tar also contains a considerable portion of acid, easily separable from it, which redundant acid injures the strength of the yarn. Both these inconveniences may be very much, if not

wholly done away, by the use of tar or pitch deprived of their mucilage and superabundant acid, which may either be done purposely by the rope manufacturer, by methods easily practicable, or its component parts may be purchased of the distillers of tar; *viz.* in essential oil of tar, and in pitch, a due combination of which will form a substance similar to the tar used in the manufacture of ropes as to inspissation, or approach to the state of pitch. This substance may, when the yarns are passed through it, either be cold, or in a moderately warm state; or of any degree of heat. Heat is however to be avoided, both as unnecessarily wasting a quantity of essential oil, and inducing such degree of injury to the yarn as arises from its exposure to great heat. If the described resinous matter be used either cold or of a moderate heat, it will be adviseable to deprive the yarn of moisture, and give it a degree of heat, previously to its entering into the resinous substance designed to impregnate and coat it, viz. by laying the yarn upon the floor of a kiln, or by any means to produce the desired effect. The essential oil of tar, which may be used to the greatest advantage in mixing with the pitch, is that of the first distillation, sometimes called brown spirit, or brown oil, of which about five or six gallons will be required to the hundred weight of pitch. Also the residuum of the second or subsequent distillation will answer, combined with a small quantity of depurated pitch. The cause of this pitch, made by the distillers, being in a great degree depurated from the mucilage, and from the superabundant acid of tar, is, that in its distillation it is mixed with water, which in the act of ebullition separates much of the mucilage and acid from the pure resinous matter; and during its distillation the essential oil and an acid spirit

spirit are thrown off together. I shall now advert to various measures which may be used by the rope manufacturer, *viz.*

He may pursue the processes of the tar distillers, and the methods before described; or he may wash the tar by agitation of it, for a due continuance, in cold, warm, or hot water; or he may boil it with water, which in the action of ebullition will agitate and wash the tar, and after it has parted with a sufficient portion of its essential oil, he may separate it from the water, and afterwards pass his yarns through it, in such a degree of temperature as he may see expedient; or he may combine any of the methods herein mentioned; and, if he chuse to save that portion of essential oil which is necessarily thrown off in inspissating the tar, he has only to clap upon his kettle the head of a still, with its apparatus.

The greater proportion of water the tar is boiled with, and the greater number of times the water is drawn off from it and renewed, the more perfectly it will be cleansed of its mucilage and acid. Two or three times the quantity of water, as of the tar, will answer very well. After it has boiled for some time, which ought not to exceed, but rather be short of, the period in which the tar will become of sufficient inspissation for use, (which will depend on the quickness of the boiling, and must be regulated by the opinion of the manufacturer,) the fire may then be slackened or put out, and the water and tar may be suffered to separate in the kettle, or they may be drawn off into a vessel for that purpose. The tar will quickly subside, and leave above it a yellowish brown water, of an acid empyreumatic taste, charged with mucilage, and having an oily scum on its surface. The vessel into which the tar and water are drawn ought to be of a conical shape, with its narrow end downwards, at the bottom of which

which should be a cock, and another about a foot higher. Through the lowest of the cocks the tar should be drawn off whilst yet warm; and through the other (or by any cock above it) the acidulous mucilaginous water may be let off. The tar thus purified should, after pouring off any water which may have risen to its surface, be put into the tarring kettle, and after boiling a little time it will throw off any water which may remain mixed with it; for which cause it was that I have recommended the previous washing and boiling, to stop short of the period of due inspissation of the tar. If the process chance to have been continued too long, the due addition of essential oil of tar will effect a remedy. The above operation of once boiling will improve the tar greatly, and extract most of the acid; but if the mucilaginous acid water be drawn off, and a fresh quantity of water be added, and a second boiling take place, the resinous matter will become more pure, and, although quickly separating from the water, it may part of it float in one or more masses, and in this case will require more attention in drawing it off from the separating vessel, or further delay until the whole of the tar has subsided.

Tarred cordage when old, or kept in a hot climate, becomes rigid, from the flying off of the essential oil of the tar, which will still more rapidly take place when used in the depurated state I have mentioned. To remedy this inconvenience in cordage, and consequently make it more durable as well as more pliable and useful, the expressed oils of vegetables, or animal oils, or fats, may be added to the more or less inspissated tar, whether it be or be not deprived of its mucilage; and to render their application more perfect the oils may be cleansed of their mucilage by processes similar to those described for cleansing the tar. Whale oil, rape oil, and linseed oil,

are,

are, from their cheapness and abundance, the most eligible of the oils. A small proportion of them, at the will of the manufacturer, may be used, according to the ductility wanted, or to the heat of the climate. Suppose the quantity wanted for the particular purpose to be one fortieth, the tar ought then to be a little more inspissated than if the oil were not used. The oil (of which I prefer that of animals) may be mixed and incorporated with it during any time of its boiling or simmering. This lubricating compound of resinous matter and oils is particularly useful in the manufacture of twice-laid cordage; which, from the rigidity of the yarns, can seldom be so far compacted in the strands as to keep out water, and therefore soon decays. By the proper use of the aforesaid compound, twice-laid tarred cordage will in all cases be very much improved; and if proper care be taken in the selection of the yarns, will be nearly as good as new rope. The methods which I deem most eligible are, either to apply to the yarns a thin solution of depurated tar and oil, laid on with a brush after the usual manner, or in any other way, or to pass the yarns drawn from old cordage through a second process of tarring, and expressing the superfluous quantity by nippers; attending also to the peculiarity of the circumstance of the yarns about to be used, which, having lost much of the essential oil of the tar formerly applied, will so far require a thinner solution of the substance afore-mentioned, than is eligible to be used in the first process. The residuum of the second distillation of the tar oil distillers, or brown oil of tar, may more or less in quantity be added to the afore-described purified tar, according to its degree of inspissation; and if the yarns be drawn from cordage tarred in the common way, it will be adviseable to use a larger proportion of animal or vegetable oils, than

for

for new cordage. If in place of inspissating the tar, for any of the uses before mentioned, recourse be had to the pitch and essential oil of the tar distillers, the essential oil ought not to be mixed with the pitch, or pitch and oil, until the latter be melted and brought to such a degree of coolness as is consistent with its proper fluidity; at which time the essential oil may be progressively added and stirred up with it, without which precaution much of the essential oil will be wasted. The animal or vegetable oils may then be added, if not done before. As to the consistency either of the pitch and essential oil, or of their mixture with animal or vegetable oils, it must be judged of and determined by the opinion of the manufacturer, which he may readily form by taking a small quantity out of the kettle, and letting it cool. The using of animal fat, suet, or tallow, as a constituent part of the substance for preserving cordage, is similar in its process to that before described; the quantity of it must depend on the degree of inspissation of the tar. It may, in my opinion, be advantageously used to one tenth of the whole, and considerably higher, were it not for the comparative dearness of it, from which cause it may be eligible to reduce its quantity to a thirtieth or fortieth part. One advantage, no further noticed than by implication, attendant on my method of using oily or greasy substances, is, that the ropes will be limber and pliable in all climates, which every seaman knows is of the utmost consequence in the working of a ship, as well as in addition to the durability of the rope. For cold climates I would recommend whale oil, and for hot climates suet or tallow, which should not be ranced as there is then a disengaged acid, for which cause fresh suet is in general preferable to tallow.

For

For the preservation of the bolt-ropes of sails, or of any other cordage in which it may be deemed expedient to incur the charge, I make use of drying oils, brought to any degree of inspissation, or of heat, according to the opinion of the manufacturer, (who must be careful to stop short of that degree of heat in which they will inflame). The ropes, or their separate strands, may be passed through any of these oils, or the yarns themselves may be passed through, and the superfluous oil be expressed by, nippers, as in the process of tarring. Resinous matter, essential oil, or any other ingredient, may be used with the drying oil, according to the views of the manufacturer.

My invention also goes to the carrying forward the before-recited improvement of the rope, immediately previous to, or during the putting of its strands together. In the usual method, the top (an instrument which separates the strands until the instant of their combining into a rope,) is made to slide uniformly, and without jerks, by previously rubbing a piece of tallow along each of the strands: now in place of tallow, I make use of any of the following compositions; *viz.* tallow mixed with a due quantity of resin or of depurated pitch, the former of which is only preferable on account of its brighter colour; and as the process is the same in both, I shall in explaining it speak of the former.

The two ingredients of resin and tallow should be melted together, and run into a cask; from which, if the resin be not superabundant, the substance thus formed may be cut out like tallow, and applied in a similar manner, by a piece being rubbed along the strands. A mixture of two parts tallow and one of resin is nearly as slippery as tallow, and in warm weather particularly a larger proportion of resin may be used, which will make the coating of the rope more durable: in place of either pitch or resin the partly

 inspissated

inspissated tar, either purified or not, but the former is preferable, may be used, mixed with tallow: also, the inspissated tar, or resin, or pitch mixed with animal or expressed oils, laid on the strands with the hollow of the hand or with a brush, will answer the end. And both as to duration and colour, with an attention likewise to cheapness, a useful compound may be made by the addition of a sufficient quantity of brown oil of tar to a due proportion of resin and boiled linseed oil, or any other drying oil, prepared with litharge or otherwise. The following proportion will answer the end; *viz.* resin four parts, boiled linseed oil four parts, and brown oil of tar three parts: the results will be that they will coat the rope with what will shortly become a dry and moderately elastic varnish.

With this coating, and all of them except that containing tallow, it will be adviseable to let the ropes lie on the stake-head-posts until a due desiccation take place.

I do not confine myself to any of the before-mentioned proportions, as they may be varied according to the opinion of the manufacturer, to the climate, and the use the rope is designed for, and to the degree of economy which may be expedient. Resinous substances, depurated or otherwise, may be mixed with any others capable of answering the purposes described; but as those I have mentioned are comparatively both cheap and abundant, it appears unnecessary to enlarge farther. In witness whereof, &c.

At the request of the Patentee we insert the following report of Mr. William Allen, lecturer on chemistry to Guy's Hospital, on the advantages of using certain preparations of tar in cordage, as above specified.

"Common

"Common tar unprepared contains a quantity of vegetable acid, and apprehending that this acid might injure the texture of cordage, the following experiment was made: A piece of twine, which by previous trial was found capable of supporiing 61 lb. without breaking, was immersed in vegetable acid, and after 46 hours it was so much injured that it broke with a weight of less than 16lb. A piece of the same twine was immersed for 46 hours in the essential oil, which came over in distillation from the tar, and although it had suffered no diminution of strength at the termination of its immersion, yet after being exposed three days to the air, it was only capable of bearing 31 lb.

"The Stockholm tar used in these experiments was found to contain about 7 *per cent.* of vegetable mucilage, capable of being converted into acid in a hot climate, when the cordage is immersed in water. The tar also contained as much real acid as there is in *an equal measure of common vinegar*; but by repeatedly boiling the tar in water, according to the method prescribed, it is freed from its acid and mucilage, and may be employed in the manufacture of cordage with great advantage in the place of common tar. Also, if the prepared tar be boiled down so much farther, as to deprive it of that portion of its essential oil, which it is found necessary to retain to prevent tarred cordage being too rigid, and the place of the essential oil be supplied with a due portion of fixed or expressed oil, it is probable that these injuries will be done away, which arise from the action of essential oil on the fibres of the hemp, and from the rigidity of cordage, experienced in vessels returning to cold from hot climates, where the essential oil is considerably thrown off."

(Signed) WILLIAM ALLEN.

Plough-Court, Lombard-Street,
28th of 7 mo. 1802.

Specification of the Patent granted to WILLIAM WILSON, *Smith, of the City of Edinburgh, and County of Mid Lothian; for his improved Plan of making, adjusting, and stamping, Scale-weights.* Dated April 30, 1801.

With a Plate.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said William Wilson do hereby declare, that my said invention is described in manner following; that is to say: My high scale-weights, such as have always been used with handles, of one pound and upwards, are made solely of hard and durable metals, without any addition of lead. They are adjusted and stamped by means of a small piece of indestructible metal, inserted into, or fixed upon, the cast-iron body of the weight. Their form is peculiar in several respects; and they are finished without the assistance of any metal softer than wrought-iron. My flat pile-weights, of four ounces and upwards, are likewise adjusted and stamped by attaching to them a piece of metal harder than lead, yet capable of receiving the impression made by the stamps.

When a high weight, of the kind here described, is cast in sand, or in a metallic mould, an opening, which appears in Fig. 1, Plate V. is left in it, of any form that will suit its position, of a sufficient deepness for the purpose of adjusting, and its surface large enough to contain the stamps; which opening is afterwards exactly filled with a piece of metal, represented by Fig. 2, heavier or lighter, as may be necessary, to render the weight perfectly conformable to the standard. When the adjusting metal is too heavy, its weight is diminished by

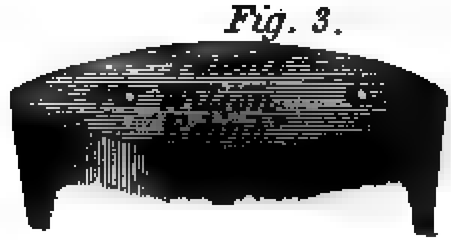
filing

Fig. 5.

Fig. 4.

Fig. 2.

Fig. 3.



filing off part of its bottom, or giving it feet, as in Fig. 3, in order to lessen its size without reducing its height; or by placing below it, for the same purpose, a bit of rolled iron, more or less turned up or down at both ends, as in Figs. 4 and 5. Upon the first mentioned piece of metal, either cold or hot, the stamps are impressed, which ascertain the number of pounds, and show the maker's name, or initials. The metal used for adjusting and stamping is fixed by two iron pins, put into the body of the weight when it is cast. These pins, which are distinctly seen in Fig. 1, go through the piece of metal, and are rivetted on the outer side, or fixed in any other sufficient manner. When a piece of metal is placed upon the surface of the weight, the method of fixing it is precisely the same; only it is attached to a *flat* weight, by making the rivets go entirely through the weight itself, and it may be fixed to a high weight in the same manner. It is not improbable, however, that, with respect to the latter, the following method may be adopted. The weight to be cast with a dove-tailed aperture in its top and side, as represented by Fig. 6. A piece of metal, represented by Fig. 7, to be fitted to the aperture, and put in from the top; and, in order to prevent its moving upwards, a screw-nail to be fixed in the upper part of the piece of metal, with its point inserted into the body of the weight. In this case the stamps are partly on the top, and partly on the side; and the weight of this piece of adjusting metal is varied by hollowing, or filing off a part of it behind, as in Fig. 8.

A weight, cast with such an opening as I have described, may be adjusted and stamped by means of lead, brass, and various other metals; and perhaps even substances which are not metallic, or compounded substances, might be found to answer those purposes. The opening

opening may be situated in any part of the weight. The piece of metal with which the opening is filled may be fixed by nuts and screws, and by other methods; or a piece of another form may be attached to the surface of the weight, in any way that may be thought proper. The weight, moreover, may be adjusted by reducing its wrought-iron handle, upon which also the stamps may be impressed, the ring being properly formed for that purpose. But the metals which I prefer are wrought-iron or steel; the substitution of an indestructible substance in place of lead being intended to prevent any deviation from the standard by common wear, while every thing else is so contrived as to render it impossible to mutilate the weight without putting it in the power of any one who examines it, merely by ocular inspection, to detect the fraud. For the cast-iron part of the weight admits of no diminution without having its surface and its form visibly marred; and the wrought-iron cannot be filed, or lessened in any way, without defacing the stamps: even the heads of the rivets and screw-nails are secured, by being stamped after the weight is finished. I rivet the adjusting metal flush with the surface of a high weight, but raised somewhat above that of a flat one; and I put it into the upper part of the body of the weight, where the stamps are most advantageously situated.

With respect to the form of my high weights, the round shape in common use is adopted with the following alterations and improvements. Their tops are considerably elevated, (as represented by Fig. 1,) that the dust may easily fall off; for hollow tops seem as if they had been contrived for the purpose of retaining it, and must either make the weights heavier than the standard, or, by occasioning frequent cleaning, reduce them below it. The edges are likewise rounded off, in order to prevent

them

them from being chipped. For the same reasons, beads and mouldings are excluded, as are all other ornaments, except an elegant simplicity of form. A variety of figure is nevertheless made subservient to another useful purpose. The avoirdupois are distinguished from the Dutch weights by a remarkable difference of form, the tops of the one being conical, and those of the other convex, while the degree of elevation is the same in both. My invention, however, as it respects the manner of adjusting and stamping, extends to every form in which scale-weights can be made. I likewise prefer the above method of adjusting weights by means of a piece of hard and durable metal, susceptible of stamps, to that of reducing a mere cast-iron weight by turning, or filing, or grinding, till it be made conformable to the standard. But the only cast-iron scale-weights which have hitherto been adjusted without lead, are flat pile-weights. High scale-weights, the bodies of which consist solely of cast-iron, are therefore included in my improvement. In witness whereof, &c.

We are requested to add, that the Patentee has assigned a share of his patent-right to Messrs. William Braidwood and Son, Ironmongers, Edinburgh, with whom he has entered into a partnership, under the firm of Braidwoods' and Wilson.

Specification of the Patent granted to AUGUSTUS FREDERICK THOELDEN, *Esquire; for certain mechanical Apparatus for supporting the Human Body, or any Part thereof, more especially during the Time of Repose, and for other beneficial Purposes.* Dated October 30, 1802.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Augustus Frederick Thoelden do hereby declare, that my said invention is described in manner following; that is to say: In general terms, I support, or suspend from the cieling, or upper part of the apartment, or from the usual framing or tester of a common bedstead, or from a frame expressly made and constituted for this purpose, a recepticle in which the human body, or any part thereof, may be placed and supported; which said receptacle, hereinafter more particularly to be described, I denominate the bed; and in order that the said bed may not only possess the advantage of being moved, placed, or swung, in all directions, after the manner of a pendulum, with regard to its centre or centres of suspension, but likewise in order that the said bed may be capable of a pleasant, easy, and salubrious motion, upwards and downwards, or by approaching nearer to, or receding farther from, the said centre or centres of suspension, in a kind of oscillatory or librating motion, I interpose between the centre or centres of suspension and the said apparatus, called the bed, a spring, of any convenient figure, or a number of springs, such as the nature and purposes of the construction may require. Then, for example, in case I adopt the use of a spring in the form of a bow, (which is as good as any,) I fix one of the moveable extremes, namely, either the crown of the

the bow or the middle point of its string, to the upper hook, or place of suspension, and I suspend the bed itself to the other moveable extremity, namely, the middle point of the string, or the crown of the bow, as the case may be. And, in order that the person, who shall be either wholly or in part supported within the said bed, may produce at pleasure the before-described alternate motion towards or from the said centre or centres of suspension, I fix a pulley at or near the said centre, through which a cord is passed, having one end thereof attached to the bed itself, and the other at liberty to be drawn by the said person, or an assistant, to produce the motion aforesaid. And in the said last-mentioned construction, as well as every other part of my said apparatus, in which cords and pullies are or may be used, I apply compound tackles, of the usual forms, whenever the same are found to be convenient or necessary. And in all cases, and whatever may be the form of the said spring or springs, I prevent the extreme of motion, and render it impossible for the spring to fail, or give way, by attaching a rope or a wire, or a metallic rod, or other fit piece, to the bed itself, and also to the centre of suspension, so that the said rope or wire, or rod, shall be fully extended and brought into action, and well and safely support the said bed whensoever the distance of the same from the centre of suspension shall be as great as the operator shall judge to be fit and proper.

The bed for supporting the entire human body or person may consist of the usual square frame, with legs, for the purpose of standing in an apartment as usual, or it may be made of any other figure, with posts, curtains, and other useful and ornamental parts, to which I have no claim to exclusive privilege, excepting so far as the same may compose parts of this

 my

my said mechanical apparatus; and the side motions of the said bed may be regulated, governed, or confined, by such framing or cords, or other geer, affixed to the apartment, or to the frame of the bed, or to both, as may be thought fit. I propose, as one of the most simple, cheap, and useful constructions, that four cords should severally proceed from the corners of the bedstead to the lower part of the spring-suspension aforesaid; and that the bedstead should be adjustable at any required heights by pullies, loops, cog-wheels, or other contrivances, for lengthening or shortening the effective part of the said cords; and I do place and construct within the said square frame two other pieces of framing, one of which is capable of rising up by hinges, so as to raise a suitable part of the bedding, together with the patient, and to constitute a support, performing the office of the back of an easy chair; and the other of the said pieces of framing is capable of being lowered down, or depressed by hinges, so as to permit a suitable part of the bedding to be depressed, and suffer the legs of the patient or person supported within the said bed to acquire more or less of a vertical position at the same time that they are conveniently supported by a foot-board, in so much, that by these two contrivances jointly the patient or persons supported may at pleasure assume the position and situation of one recumbent in bed or sitting up in a chair. And these respective motions of raising and lowering the said last-described pieces of framing can be readily produced by the said person himself, or any assistant, by means of a simple pulley and cord to each end, with or without a tackle, and forming communication between the said moveable frames and the superior part of the said bed at or near its place of suspension by the spring. The bedding may be disposed either

above

above or below the ticking, and in the latter case the same may be applied and kept in its place by a proper application of straps, by which means the said bedding may be removed and shaken up, and again replaced without disturbing the patient in the least. And, moreover, by cutting a hole in the ticking an aperture may be made, of the most convenient use, for the natural evacuations, or for other purposes of salubrity and curative processes.

For the construction of cradles, or small beds for children, an appropriate frame may be made, to the upper part of which the spring is to be attached, and the sides thereof may, by sliders or stops, or otherwise, so govern and confine the motion as to restrain it altogether to the vertical oscillation, or leave the pendulous motion more or less at liberty, as may be required.

I likewise use the aforesaid mechanical apparatus, with its spring or springs, to suspend sofas, chairs, and other sorts of seats, with or without moveable backs, for the repose of the human body.

The new suspension herein-before described is applicable, and attended with the more happy effects in the support and suspension of broken or diseased limbs, or parts of the human body. My apparatus for this purpose is particularly described as follows: First, I make my suspension by means of one or more springs, either from the cieling or upper part of the apartment, or from the usual frame or tester of a common bedstead, or from a frame expressly made and constructed for this purpose, and I apply the cord or rod to prevent accidents, as herein-before described; by which means the limb is suffered to acquire, when necessary, a gentle and easy motion up and down, and also in every required horizontal direction. Secondly, I fix a

P 2 pulley

pulley to the lower moveable part of the spring, and the sheave or wheel of the said pulley is confined in its cell or block, so that it becomes what in sea-language is called a dead-eye, or I simply use a ring or loop instead of the said pulley. I pass a cord through the last-mentioned pulley, ring, or loop, the extremities of which cord are applied to support the two ends of a board, which constitutes part of the bed or receptacle for the limb. The said cord is not fastened immediately to the board, but to two loops of cord, which pass respectively through two holes at each end of the said board, and the said first-mentioned cord is fastened permanently to one of the said loops; but at the other extremity it is provided with a number of eyes or openings, into which an hook from the other loop can be inserted at pleasure, and lengthen or shorten the whole effective part of the said first-mentioned cord: by this method of suspension, the board may be raised or lowered, and placed in any position, with regard to its length, by drawing down one or other of the extremities of the cord which passes through the dead eye or ring; and it may be also placed in any position with regard to its breadth, by means of the loops at the end, which can be slided in the holes of the board. Thirdly, I suspend beneath the said board, longitudinally, a flexible receptacle for the leg or limb, made of cloth, leather, or any other fit material, with a piece or stump of the same, to form a rest for the sole of the foot, attached by a string to one of the pegs hereinafter described. To the edges of the said receptacle, which may be stiffened by a thin slip of wood, whalebone, or any fit material, if thought convenient, I tie or loop certain strings to hooks, which are engaged in the eyes or holes in the edges of the said flexible receptacle; and the said strings pass upwards over the edges of the

said

said board, and thence are wound respectively through and round certain pegs, resembling those of musical instruments; which said pegs may be disposed in a line along the middle of the said board, each peg being used to raise and lower at the same time the string attached as aforesaid to the opposite points of the said receptacle. By the aforesaid strings the said cloth can be applied more or less firmly against the different parts of the said limb, so as to support the same in the most easy and comfortable manner. And in case it should be necessary to uncover a part of the said limb, while the rest of the limb remains suspended, the cloth or receptacle may be made to consist of a number of separate pieces, each supported by strings, as before described, which may be slackened or disengaged while all the others continue to perform their office; or in case of any discharge of humour from the said limb, any part thereof may by this means be left uncovered, and dressings may be changed or removed, and fit vessels, or other proper applications, may be duly placed or suspended, accordingly as the nature of the indisposition, or other circumstances, may demand. And for the purposes of warmth, clothing, or defence against the external air, it is easy to apply the usual framing over the board, to keep off the bed-cloaths, along with this machine, in the same manner as is now practised in ordinary cases: or otherwise small openings may be made in the cloathing, to admit the spring or cords, so that the board shall be either above or beneath the cloaths and the receptacle and limb in all cases. Besides which, many easy and obvious arrangements in the dimensions, as well as in the use of the apparatus, will be perceived by the intelligent operator, and need not here be described. In witness whereof, &c.

Description

Description of an Apparatus for impregnating Water and other Substances strongly with Carbonic Acid Gas.

By the Rev. GILBERT AUSTIN, *M.R.I.A.*

From the TRANSACTIONS of the ROYAL IRISH ACADEMY.

THE carbonic acid gas, or other gas, is generated in phials *a*, *a*, (see Plate VII. Fig. 1,) with bent tubes in the usual manner, and received in the jar *b*, placed on the shelf of the pneumàtic tub. When the jar *b* is filled, the phials are applied to others, which are filled also, and reserved to replenish the jar *b*. To this jar it may be convenient to fit the stop-cock *d*, communicating with the bent tube *e*, or the bent tube *e* may be used without the stop-cock, and be fitted immediately into the neck of the jar. At the end *f* of the bent tube is a valve opening into the tube *g*, and at the opposite end of the tube *g* is another valve *h*, opening into the stop-cock *i*, which communicates with the strong glass vessel *l m*. To the tube *g* is adapted the condensing syringe *k*, which is placed between the valves *f* and *h*. The tube *g* is firmly fixed to the stand *n*, so that the condensing syringe may be worked without disturbing the apparatus: all the joints must be well fitted, and perfectly air-tight.

The use of this apparatus must be obvious. The parts are all to be screwed together, as in the figure, except the strong glass vessel and its stop-cock; the phials are also to be removed. The jar *b* being placed on the shelf of the pneumatic tub will, in these circumstances, contain a portion of the common air of the apartment. In order to remove this, the piston of the condenser is to be raised; upon which the valve at *h* will close, and that at *f* will open, and admit into the vacuum, formed in the barrel,

Fig 2.

barrel, a portion of the common air contained under the jar, and the water will rise in the jar in proportion to the capacity of the barrel of the condenser. On thrusting down the piston the valve *f* closes, and the air is expelled through the valve *h*. This operation is repeated till all the common air is removed from the jar *b*, and the water completely fills it. The strong glass vessel *l m*, with its stop-cock, is now screwed on. It is nearly filled with the water to be impregnated, but not quite, a small portion *m* of air being left, in order to allow room for the agitation of the water. The jar *b* is now to be filled with carbonic acid gas, which is pumped up and forced into the glass vessel in as large a quantity as it will admit without danger of bursting, which in my vessel, containing about a pint measure, is about an equal bulk of gas. The glass vessel is then to be taken off (its stop-cock being previously closed) and agitated briskly; and as the water absorbs the gas more readily when many of its particles are thus forced into contact with it, the condensation may be repeated several times. It appears useful, in order to expel the bubble of common air left in the vessel for the convenience of agitation, after two or three condensations, to open the stop-cock, and suffer it to be expelled, and then to renew the charge of the carbonic acid gas. In a very few minutes water may thus be acidulated to any degree (provided the apparatus is sufficiently strong and close), so as even to foam out of the glass vessel like liquors highly in bottle, as soon as the stop-cock is opened.

As the carbonic acid gas may be quickly generated or preserved for any time in bottles closely stopped, artificial mineral waters, in great perfection, may by this apparatus be prepared as soon as any other medical prescription.

The

The apparatus I have constructed is of brass; and however carefully cleaned, perceivably imparts a taste of the metal to the water. It is adviseable therefore to make it of some metal which either may not possibly impart any sensible taste to the water, or which may not be considered injurious even if dissolved in it in very small portions; silver or tin appear best adapted for this purpose, but as the former may be too expensive for general use, and as the latter is too soft to bear well the frequent screwing and unscrewing necessary in the use of the apparatus, the channels through which the gas passes may be well coated with silver or tin, which may answer the purpose; the pipes and cocks may have a thick silver wire soldered in the centre, which may be perforated, and the condenser may be well plated or tinned on the inside.

But as glass appears to be the most unexceptionable material, I have ordered an apparatus to be constructed entirely of glass, and have hopes that I shall have it so executed as not to admit any thing else to come in contact with the gas. As the difficulty of execution may however cause a variation in my plan, I shall defer the laying it before the Academy till I get it accomplished to my wish. Ingenious workmen may also be induced to contrive and execute some apparatus which may answer the purpose, should my ideas seem practicable to them, or useful for philosophic experiments.

As disagreeable accidents might arise from the bursting of the glass vessel, an ingenious mechanical friend has suggested to me the propriety of inclosing it in a strong copper case. It may consist of two hemispheres with a broad rim screwed together, as in Fig. 2.

Account

Account of a Method of improving Waste Land. By THOMAS FOGG, *Esquire, of Bolton in the Moors, Lancashire.*

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

The Gold Medal was voted to Mr. Fogg *for this Communication.*

THE following is a description of the waste land I have inclosed from the common called Edgworth Moor, in the parish of Bolton, and county of Lancashire, by an act of parliament, granted for that purpose; and also an account of the method which I have taken for the improvement of the said waste.

Upon one of the small plots I have built a farm-house, cow-house, and a room above for hay.

Five of the plots were all of similar black soils; the situation, a gentle descent to the south, of about one inch to the yard. One of these plots I manured upon the green swarth; but the soil being too wet, it did not answer my expectations. I then drained all the five plots with stone, laying bottoms underneath. The main drains opened about two feet square, and smaller drains are directed into them. I afterwards covered the land with compost made from lime, soil, and black dung, which answered very well; and they are now as good meadow and pasture lands as any in the neighbourhood.

On a small plot I have walled out a nursery for plants, in which I have about 6000 two-year-old and one-year-old trees: these I take up, and plant out as I have occasion.

Two of the plots were alike very bad, and bare of soil; they produced nothing but bent grass. On many parts

of them there was no soil, large beds of rocks appearing on the surface: these I got up, and made part of the walls with them, levelling the land at a great expense. I then covered the ground with a compost of lime and rich black soil, produced from decayed timber and vegetables; which soil I dug out of one part of the premises. With the above compost I covered the two plots, from three to four inches thick. The cattle seem to like this pasture better than any of my old inclosures. It has a south aspect, falling from north to south three or four inches in a yard.

Another plot I have improved upon the same plan as the two last, and have no doubt of its answering: but as it has been only done this year, I must attend until the next year to ascertain it. It has a north-east aspect, with a fall of about one inch to the yard from the south.

Two other plots were very boggy and full of small pits, whence peat had been got. Many places were not passable, being full of water: these lots I have levelled and drained, with open drains, at a great expense, as they would not bear the cattle to tread upon them. I first made a large drain, which answers the purpose of a fence: it is three yards wide at top, one at the bottom, and two deep. I then cut small drains directed into it, about four yards asunder; with the soil from which I filled up the pits, and where the land wanted I put it sometimes on the middle of the butts, after hacking it small. These small drains are about one foot in width, and from twelve to eighteen inches deep; taking care not to go into the clay. These small drains are cut by a line: I paid for them $1\frac{1}{2}$*d.* *per* rood, of eight yards. These plots have a north-east aspect, with a gentle inclination from the south. They are now as dry as any land I have, and fit for any manure; I have about 500 loads of soil

heaped

heaped up for that purpose, which I mean to mix with lime next spring.

Another plot, which is nearly flat, I have drained with open drains, and levelled the land, which is now dry enough for tillage.

Another part I have planted with Black Italian Poplar, Lombardy Poplar, Beech, Scotch-Fir, Larch, Sycamore, Ash, Alder, Huntingdon-Willows, and a few Oaks; they flourish well in general: the Larches seem to thrive best, and the Sycamore next. This plantation is double-railed to the west: I have platted brush-wood in the rails, and fastened it in the ground.

I drained other parts of the land which were mossy, and planted one plot thereof, which had from three to four feet deep of good black soil, with potatoes. A person of the name of Duckworth, who is unacquainted with my application to your Society, told Mr. John Ashworth, of Turton, the secretary to the Manchester Agricultural Society, that he had weighed the potatoes grown in two different places of it, and the produce was above $7\frac{1}{4}$ lb. to a square yard upon the average.

	£.	s.	d.
Expenses — In walling fences 500 roods, 8 yards to the rood, from 5 to 6 feet in height, at 8*s*. 6*d*.	212	10	10
Expenses — $6\frac{1}{2}$ statute acres covered with stone drains, at 3*s* *per*. rood, 8 yards to the rood. The same ditto with black soil, lime, and dung, at 6*s*. *per* rood; in all 9*s*. *per* rood	221	17	0
Carried over . .	£.434	7	10

	£.	s.	d.
Brought over . .	434	7	10

This land was worth about 5*s.* *per* statute acre in its original state, being of the nature of black soil, producing bent, and is now good meadow and pasture land, and valued at 3*l.* *per* statute acre.

Expenses of 13 statute acres covered with black soil and lime, of sufficient depth to have carried a crop of oats, which was sown with grass seeds, supposed to have cost 6*s.* *per* rood	294	18	0

This land was worth about 3*s.* *per* acre in its original state, being of the nature of black and hazel soil, and producing black heath and bent, and is worth about 2*l.* 2*s.* *per* acre.

Expenses — 2 statute acres of land fenced out, and sets found for many poor people to plant for potatoes at 10*l.* *per* acre	20	0	0

This land was worth about 2*s.* *per* acre in its original state, being of the nature of black soil, and producing nothing but rushes, and is now worth about 2*l.* 2*s.* *per* acre.

Carried over . .	£.749	5	10

Expenses

	£.	s.	d.
Brought over . .	749	5	10
Expenses — 3 statute acres of land planted with timber of different descriptions, which seem to be in a flourishing condition. This land is fenced with double rails and brushwood, to keep the west and north winds from the trees. It cost more than 20*l.* *per* acre	60	0	0
This land was worth about 2*s.* *per* acre in its original state, being of the nature of black soil, producing bent grass.			
Expenses — 26 statute acres levelled and drained with open and covered drains, at present very dry, and the next spring will be ready for any sort of manure, which we believe cost about 200*l.*	200	0	0
This land was worth about 2*s.* *per* acre in its original state, being of the nature of black soil, and producing black heath and bent grass, and is now worth about 1*l.* 11*s.* 6*d.* *per* acre.			
Total . .	£.1009	5	10

Experiments

Experiments and Observations on the Heat and Cold produced by the Mechanical Condensation and Rarefaction of Air. By JOHN DALTON.

From the MEMOIRS of the LITERARY and PHILOSOPHICAL SOCIETY of MANCHESTER.

IF a thermometer be inclosed in a receiver, and the air suddenly condensed, the thermometer rises a few degrees above the temperature of the atmosphere; and if the air be exhausted from a receiver inclosing a thermometer, the mercury sinks a few degrees immediately; but in both cases after some time it resumes its former station. These facts are well known to philosophers of the present age, but they do not all agree in the explanation of them. Thinking the subject worthy of elucidation, I was induced to institute a series of experiments for the purpose, which I apprehend have led to a clear demonstration of the cause of the phenomena, and moreover make the facts themselves appear in a somewhat different point of view from what they are seen in at the first moment

One circumstance is very remarkable, that whether the mercury rises or falls in these instances, it is done *very rapidly;* whereas in the open air, if a thermometer be only two or three degrees above or below the temperature, it moves very slowly. This seems to have suggested to every one the idea that the elasticity of the glass bulb of the thermometer has a principal share in producing the effect, by causing the bulb to yield a little to the pressure of the air. It has however been found upon trial, that the same effects take place whether the thermometer is sealed or not. My experiments accord with this, having made a thermometer and left it unsealed for the ex-

press

press purpose; in all the experiments with condensed and rarefied air, there was no sensible difference observed to arise from the inequality of pressure on the external and internal surfaces of the bulbs, the sealed and open thermometers varying the same in kind and also in degree, except from circumstances to be noticed hereafter.

It being certain then that a real change of temperature takes place, it remained to determine the quantity and manner of that change. Having chosen a small, and consequently sensible thermometer, with a scale of degrees sufficiently large to admit of distinguishing one-tenth of a degree, I proceeded to ascertain several facts experimentally.

Experiment I. Took a receiver, the capacity of which was about 120 cubic inches, and suspended the thermometer with its clear bulb in the central part of it; then letting the whole acquire the temperature of the room, which was without a fire, I exhausted the air, and afterwards restored it, marking the effects upon the thermometer. The medium of several trials, nearly agreeing with each other, was as under:

The thermometer

——— in the air of the room stood at . .	36°.8
——— sunk upon exhaustion to	34 .7
——— rose when the air was restored to .	38 .9

The *suddenness* of the fall and rise puzzled me most: after reflecting upon it for some time, I conjectured that the real change of temperature of the air or medium was much greater than the thermometer indicated, but that the inequality existed only for a few seconds of time, because the receiver, &c. immediately impart heat to, or abstract it from, so small a quantity of air as 120 cubic inches, which are only equal to 40 grains in weight. —

The

The phenomena of the thermometer seemed very well to accord with the supposition of *great heat or cold* acting upon it for a few seconds only.

Experiment II. Pursuing this idea, I imagined that if two thermometers, whose bulbs were very unequal in magnitude, were inclosed together, the smaller bulb ought to give the greater variation: accordingly I inclosed two, the diameters of their bulbs being .35 and .65 of an inch respectively; and having exhausted the air, and restored it again repeatedly in succession, and found a mean of the variations, that of the small bulb was 20°.8, and that of the large 2°.2.

Experiment III. Repeated the exhaustion with the small thermometer, inclosed in three different circumstances successively; 1st, with the bulb in the centre of the receiver; 2d, with the bulb resting on the wet leather of the plate; and, 3d, with the bulb resting against the side of thr receiver.

1st Case—Reduced by exhaustion . . .	2°.45
2d Case—	2 .15
3d Case—	1 .2
1st Case—Raised by restoring the air . .	4 .05
2d Case—	2 .25
3d Case—	2 .8

Experiment IV. Inclosed a wine glass with about a cubic inch of water in it, containing the bulb of a thermometer, in a receiver; and, exhausting the air, the thermometer sunk half a degree suddenly, and then continued stationary; upon restoring the air it suddenly rose half a degree.

All these experiments confirmed my conjecture of a much greater degree of heat and cold being produced in these cases than the thermometer points out, but that its continuance

continuance is so short as not to effect a material change in the temperature of the mercury. The following experiments were made to ascertain what may be the *real* degree of heat and cold generated in those operations.

Experiment V. The same receiver and small thermometer as above being used, I found the exhaustion was effected by working the pump *one minute*. The thermometer sunk nearly 2° in the first half minute; and the remainder, a few tenths of a degree, in the latter half minute. The operation being stopped, and things remaining in the same state, it required some minutes of time before the thermometer recovered *one* degree of the heat lost. Upon opening the cock, the receiver filled with air in five seconds, and the greatest velocity of the rising mercury was about the end of that time. The rising continued for thirty or forty seconds from its commencement, but three-fourths of the effect were produced in the first ten seconds. The greatest velocity of the rising mercury is 1° in 3½ seconds. After the thermometer had attained its utmost height, it began to fall again at the rate of one-tenth of a degree in a minute.

Experiment VI. Took the same thermometer and heated it to 50° above the temperature of the air; then let it be cooled by the medium of air, and it began to fall at the rate of 1° in 3½ seconds.

The two last experiments seem to prove that when air is let in to the receiver in the ordinary way, *an increase of temperature of 50° is produced in the medium within the receiver for 3½ seconds*. This high temperature is reduced, *in a few seconds*, by the receiver and surrounding bodies, to their own temperature.

Experiment VII. *On condensed Air.*

Took a large spherical glass receiver, the capacity of which was something more than twice that of the former (above one gallon), and suspended a thermometer in the centre of it, of a larger bulb than that before used; the receiver had a brass cap and stop-cock adapted to it: then doubled the density of the air within it by a condenser. The thermometer rose 2° or more. Let out the air suddenly, and the thermometer immediately sunk each time from 3° to 3°.5; at the same time an exceedingly dense mist was produced in the receiver, which soon subsided.

Suspecting that *aqueous vapour*, which always exists in the atmosphere, and is liable to assume the liquid or aërial form according to circumstances, might be the principal agent in the production of heat and cold by condensation and rarefaction, I thought that an increase of it might produce a greater effect, and that cold air, which contains less vapour, might have a less effect. The reverse, however, was the fact, as appears by the following:

Experiments VIII and IX. In a cold morning last winter, when the air was clear, and the thermometer without stood at 20°, I took the receiver and condenser into the open air, and let them stand for fifteen minutes, to acquire its temperature; then repeatedly condensed the air to a double density, and suddenly liberated it again. On a medium of five trials, the mercury fell 3°.3 on opening the cock. — The vapour precipitated was whiter than usual, and not nearly so dense.

Again, took the receiver and condenser into a dyer's stove, where the temperature was about 100°, and the air

air abounded with vapour in a transparent state: after some time, condensed the air and liberated it as before, when on a medium of five trials the mercury sunk only 3°, and a very copious mist was precipitated, so dense that one could but just distinguish the degree of the thermometer through it.

These experiments shew that the greater the quantity of vapour condensed the less is the change of temperature; and that consequently, if air was entirely free from vapour, the change of temperature would be a *maximum*. Indeed this is clearly consistent with the known law, that when vapour is condensed, heat is given out. Any process to cool the air must be retarded by the condensation of part of the vapour it contains. Suppose, for instance, that a portion of the atmosphere contained $\frac{1}{60}$ of its weight of aqueous vapour, and that $\frac{2}{5}$ of this vapour were condensed by 50° of cold, that is, $\frac{1}{150}$ of the whole elastic mass was converted into water; then the heat given out would be sufficient to raise the temperature of the remaining mass of air and vapour 6 or 8°, which sufficiently accounts for the small difference observed in the results upon warm vapoury air and cold dry air. Hence vapour, far from producing the change of temperature in question, tends to diminish the effect.

If any doubt remained with me respecting the *real* change of temperature that takes place in the operations related above, it was completely removed by the results of the two following experiments.

Experiment X. Inclosed a small graduated glass tube of $\frac{1}{15}$ of an inch internal diameter, and 10 inches long, with a short column of mercury in it, in the large receiver; the tube was sealed at one end and open at the other, so that a portion of air, of given capacity, was

confined by the mercurial column, which was near the open end of the tube, and subject to rise or fall by any variation of elasticity of the air on either side, being a proper manometer: then doubled the density of the air in the receiver, and opening the stop-cock, the mercurial column soon ran up to its former station, but instantly turning the cock again, the mercurial column returned or fell down gradually for 5 or 10 seconds, to the amount of nearly $\frac{1}{10}$ of the whole aërial column, and then became stationary. Again opening the cock, a quantity of air rushed out, and the mercury resumed its original station. These effects were always the same, on a repetition of the experiment.

Experiment XI. Let the mercurial column of the manometer down by a wire to $\frac{1}{4}$ of the length of the tube from the sealed end; then exhausted $\frac{1}{2}$ of the air from the receiver, which was seen by the mercury rising to the top of the tube; and upon opening the cock the mercury fell to its former station, but then suddenly turning the cock, the mercury gradually rose for the space of 5 or 10 seconds to *more* than $\frac{1}{10}$ of its original height above the stationary point, and remained there till the cock was opened; after which it resumed its proper station.

The phenomena in the two last experiments can be explained only on the following principle: — The air in the receiver and in the manometer is subject to a like degree of rarefaction and condensation in those experiments, or very nearly so. When the equilibrium of heat in the air is disturbed by the operations of condensation and rarefaction, it is restored in the manometer *instantly* by reason of the contiguity of the glass to the air; but in the large receiver it requires a sensible time, of ten seconds or more, to restore the equilibrium throughout the whole in-

ternal

ternal capacity. It is this restoration that increases or diminishes the elasticity of the air confined in the receiver, and thereby causes the retrogradation of the mercurial column. Now I have found, by former experiments, that a change of 50° in temperature effects a change of $\frac{1}{10}$ nearly, in the capacity or bulk of air. It follows therefore that in the case of restoring the equilibrium in condensed air, about 50° of cold is produced; and in letting in air to an exhausted receiver, something more than 50° of heat is produced. The small difference seems to arise from this, that the condensation of vapour in the former case *diminishes* the effect; and in the latter, if any there be, *increases* the effect, that would arise from operating upon purely dry air.

The experiments and observations hitherto related go principally to ascertain facts without any reference to the theory of them: this, however, may be given in a few words, and is the same that is inscribed to Mr. Lambert by Messrs. Saussure and Pictet, and by them adopted. He conceives that a vacuum has its proper capacity for heat, the same as air, or any other substance; and that the capacity of a vacuum for heat is *less* than that of an equal volume of atmospherical air; also that the *denser* air is, the *less* is its capacity for heat: upon these principles the phenomena are easily referable to that class of chemical facts where heat and cold are generated by the mixture of two different bodies. — If this theory be right, and I think there is little doubt of it, we may hence be led into a train of experiments, by which the absolute capacity of a vacuum for heat may be determined; and likewise the capacities of the different gases for heat, by a method wholly new: — but this must be left to future investigation.

Description

Description of an improved Capstan or Windlass. Communicated by Captain THOMAS HAMILTON, *of the Royal Navy.*

With a Plate.

MY intention in the present instance is to demonstrate the form a capstan should obtain, relative to the friction of the messenger, when weighing anchor.

It is generally known in ships of war, when heaving at the capstan with but little strain or resistance, there is a difficulty to hold on the messenger; and, on the contrary, when heaving with a great strain, it is often found necessary to slack the messenger to let it surge or rise up the whelps of the capstan.

To use mechanical language, the surge or power to prevent the descent of the messenger * with three and a half turns round the capstan, is too great for the friction when applied to little comparative weight or strain; and the surging power is too little for the friction, when applied to a great weight or strain.

The surge of the capstan is the angle from the perpendicular the outline of the whelps make, and in our capstans is about $9\frac{1}{2}$ degrees uniform from top to bottom, the outline of the whelps being straight; it follows, the less that angle is, the surging power is proportionally diminished, and conversely increased.

To counteract the surging power, the number of the whelps have been reduced from six to five, forgetting the friction or descending power is increased in the same

* The messenger is the rope fastened to the cable, and passed round the capstan, to weigh the anchor.

ratio,

Fig. 1.

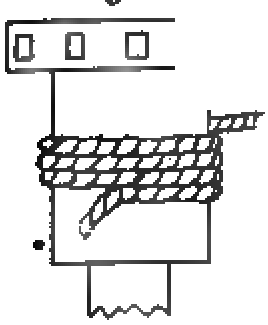


Fig 2

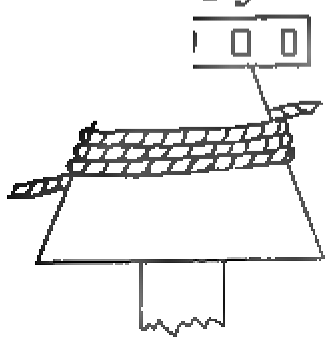


Fig. 5.

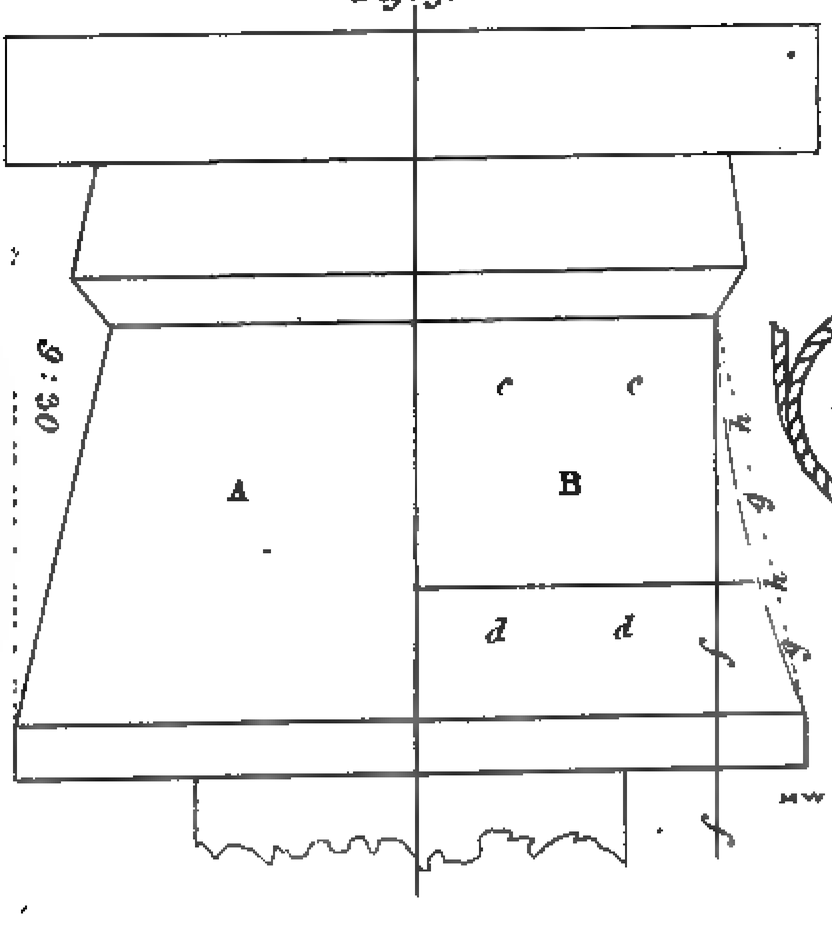


Fig. 3.

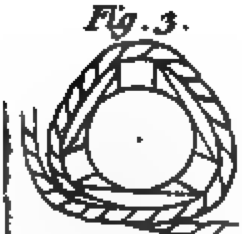
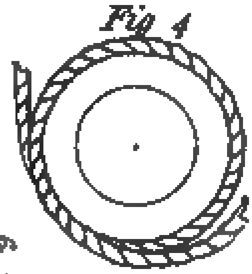


Fig 4



ratio, the surge or ascending power is diminished; hence the use of lifters, rollers, &c.

Four powers relative to the friction may be considered as belonging to the form or figure of the capstan; two of which may be called ascending powers, and two descending powers.

1st. Reducing the angle of the whelps, or approaching a cylindrical form, greatest descending power. (See Plate VII. Fig. 1.)

2d. Increasing the friction, by reducing the number of the whelps, second descending power, (see Fig. 2.)

3d. Increasing the angle of the whelps, or deviation from a cylinder, greatest ascending power, (see Fig. 3.)

4th. Adding to the number of whelps, or approaching the circle, second ascending power, (see Fig. 4.)

In this plan it will be perceived that the two descending powers are applied to the upper part, and the two ascending powers to the lower part of the capstan, and may be altered till the just angle of the surge is attained; though I have no doubt the present angle is very near the truth, and was quite sufficient in the trials I was witness to in His Majesty's ship Argo, where twice a very great strain never caused the descent of the messenger an entire turn round the circular part of the capstan.

The following letter, from Commodore Hallowell, an officer fully competent to judge, which the Commissioners of the Navy were so good as to send me, will convince those, who are ignorant of mechanicks, of the advantage to be derived from adopting the proposed form for either a capstan or windlass, and save much expense or vexation, and probable mischief.

N. B. The lifters which are ordered for the use of the Navy are, upon an average, not less than 20*l.* expense for each capstan.

References

References to Plate VII.

Fig. 1, greatest descending power.

Fig. 2, second descending power.

Fig. 3, greatest ascending power.

Fig. 4, second ascending power.

Fig. 5, A, capstan as usually made, 9.30 angle of the surge. B, as fitted in the Argo. *c c*, open as usual. *d d*, filled up with the chocks circular, making the lower part nearly a troncated cone. *f f*, tangent to the arc *g g*. *g g*, arc of a circle to the cord *h h* and tangent *f f*. *h h*, outline of the whelps usually made, and cord to the arc *g g*, as altered in his Majesty's ship Argo.

Copy of Commodore Hallowell's *Letter to the Commissioners of the Navy.*

His Majesty's Ship Argo, in the Downs, Oct. 31, 1802.

Gentlemen,

On the first trial made at Long Reach with our capstan and roller when unmooring, I observed the roller to be of no use, as the messenger never required its assistance; I therefore ordered it to be removed, and, in repeated trials made between Long Reach and the Downs (having anchored six times), I am perfectly satisfied that the roller is useless with such a capstan as is fitted in the Argo, which is nothing more than the old one with the lower part made more obtuse, and filled up circular by the chocks, and the upper part more perpendicular in the sides, and open. The alterations in the common capstan may be made without any expense, farther than the men's time employed in reducing the upper part of the surge, and putting the filling pieces to the lower part, and I am certain will be approved by every person who

tries

tries them. The rollers will be found of great service where capstans of the common form are used, and in that case the stantion of the roller should not be so high as the one fitted in the Argo, but just of sufficient length to allow the roller to traverse clear of the deck, which would give more room for the turns of the messenger round the capstan, and make the support of the roller greater. But the expense, and occasion for them, will be totally avoided by the trifling alteration being made in the capstans.

I am, &c.

(Signed) BENJAMIN HALLOWELL.

Experiments on the Cause of the Coagulability of saponaceous Solutions, and Indication of a Method of discovering the Quality of Soap. By M. VERBERT.

From VAN MONS' JOURNAL DE CHIMIE.

NOTHING is frequently more difficult than to discover, by sight, the quality of white soap, as this substance may be composed of very different ingredients, and still preserve the same exterior appearances.

A research which I made into the nature and qualities of soap, furnished me with a method of distinguishing the nature of the elements composing that substance. The following are some of the experiments that led me to this result.

In a preceding experiment, intending to dissolve one part of white soap, which appeared to be of good quality,

lity, in eight parts of spirit of wine, at 26° of Baumé, instead of a limpid solution I obtained an opaque liquor, resembling jelly when cold. A more perfect solution was not effected by 64 parts of fresh spirit, which I added to it. A similar solution was produced by the same soap with alcohol, common spirits of wine and water. One part of this jelly communicated its character to four or five parts of the spirit of soap. This jelly was rendered limpid by heat: I submitted it to distillation in a glass retort, and obtained a thick greasy residuum, soluble in water, but not transparent.

Oxysulphuric acid diluted with water and other oxygenated acids, separated from the jelly a greasy dirty matter, which stuck to the fingers. It is well known that oxygenated acids separate the oil in its natural state from soaps that have been properly prepared. Having prosecuted this labour no farther at the time, I resolved to resume it, by endeavouring to discover, by synthetical researches, the composition of this gelatinous soap.

1. I made a soap by uniting, by trituration in a glass mortar, two parts of olive oil to one part of caustic alkaline ley, newly prepared. This soap was very perfect.

2. To ascertain whether an incorporation of starch might not perhaps have been the cause of the formation of the jelly, I mixed one part of that substance in powder with six parts of the soap just described, before it acquired a consistence: but a warm solution of this soap in spirits of wine precipitated the starch.

3. I incorporated with one part of ley two parts of melted tallow and one-fourth part of starch. In the space of two or three hours it formed an extremely hard soap, which

which produced a jelly with spirits of wine and water. This jelly, with the last-mentioned liquid, in the proportion of one-eighth was opaque; with one-fourth it formed an apparently excellent soap: fifteen parts, dissolved in eight parts of water, communicated the gelatinous consistence to 120 parts of spirits of wine. An aqueous solution of this soap from tallow was milky, like an emulsion.

4. I made the soap (No. 3) without adding starch. The produce was the same, but the jelly which it formed had less consistence.

5. Ley and grease combined in the proportion of one to two yielded a very white and hard soap, which rectified spirits of wine dissolved when warm, by separating from it some flakes of a whitish matter, but the solution of which assumed the character of jelly when cold. Its aqueous jelly was however less firm, and a solution of it not so white as with the soap made of tallow.

These different results confirm what Struve had before hinted relative to the cause of the congelation of saponaceous solutions. In spirits of wine they furnish a certain re-agent for ascertaining the quality of a soap by pointing out the oily or sebaceous nature of the fat substance of which it is composed. I have likewise observed that soap made of tallow requires, for congealing, twice as much spirits of wine as that made of grease.

On the Wax Tree of Louisiana and Pensylvania.

By Charles Louis Cadet, *of the College of Pharmacy.*

From the Annales de Chimie.

A Multitude of plants, as the *croton sebiferum*, the *tomex sebifera*, of *Loureiro*, the poplar, the alder, the pine, yield by decoction a concrete, inflammable matter, more or less resembling tallow or wax; that is to say, a fixed oil, saturated with oxygen. The light down, which is called the flower of fruits, and which silvers the surface of plumbs and other smooth-skinned fruits, is wax, as M. Proust has demonstrated. But the tree which affords this substance in the greatest abundance, that which on more than one account deserves the attention of agriculturists, chemists, physicians, and commercial men, is the myrica cerifera, or wax-tree.

We find in the History of the Academy of Sciences for the years 1722, and 1725, that M. Alexandre, a surgeon, and correspondent of M. Mairan's, had observed in Louisiana, a tree of the height of a cherry-tree, having the appearance of a myrtle and nearly the same smell, bearing a berry of the size of coriander seed. These berries, of an ash-grey colour, contained, he said, a small, hard, round kernel, covered with a glossy wax, which is separated by boiling the berries in water. This wax is drier and more friable than the common wax. The natives of the country make candles of it. M. Alexandre added, "this berry is commonly charged with a beautiful lake colour, and stains the fingers if merely squeezed between them, but only at a particular time of the year."

M. Alexandre likewise discovered, that the liquor in which the berries have been boiled, when poured away and evaporated

evaporated to the consistence of an extract, having previously skimmed off the wax, was capable of stopping the most violent dysenteries.

The useful properties belonging to this tree should induce scientific men to make enquiries, for the purpose of discovering what varieties there are of this vegetable, and what care is requisite for its cultivation. It appears to have been considered for a long time as merely an object of curiosity.

Linnæus, in his System of Vegetables, mentions only the Virginia wax-tree, *myrica cerifera*, with lanceolated, or rather dentated leaves, with a stem like a tree.

I wrote to M. Ventenat, requesting him to inform me, whether there are several species of it: he was so obliging as to answer me, that Ayton distinguished two, namely;

1. The *myrica cerifera angustifolia*, which is a native of Louisiana. This is a delicate tree, is reared with difficulty in our green-houses: its seed is smaller than that of the other.

2. The *myrica cerifera latifolia*, which grows in Pensylvania, Carolina, and Virginia. It is not so high as the other, and thrives perfectly well in France.

Both of these myricæ are cultivated in the Museum of Plants, and in the garden of Messrs. Cels and Lemonier. M. Michault admits a third species of myrica cerifera, which he calls *dwarf wax-tree*. M. Ventenat thinks that wax may be obtained from all the myricæ.

The authors who have treated of these trees at some length are, Marshall, translated by Leserme, Lepage, Duprat, and Toscan, librarian of the Museum of Natural History. A memoir inserted by the latter in his work entitled, *L'Ami de la Nature*, describes the manner in which the vegetable wax is obtained in the colonies.

"Towards

"Towards the end of autumn," says he, "when the berries are ripe, a man quits his house, with his family, and betakes himself to some island or spot on the sea coast, where the wax trees grow in abundance. He carries with him pots for boiling the berries, and a hatchet for building a cabin to shelter him during his residence there, which usually continues three or four weeks; he then fells trees, and constructs a hut, whilst his children gather the berries. A tree, tolerably productive, yields about seven pounds. When a sufficient quantity of berries is collected, the family employs itself in extracting the wax. A certain portion of the berries is put into the pot, and a sufficient quantity of water is poured on them, until it rises about six inches above them. The whole is boiled, and the berries are stirred and pressed, from time to time, against the sides of the vessels, that the wax may be the more easily detached. Soon after it is seen floating on the surface in the form of grease, which is collected with a spoon, and is strained through a coarse cloth, to separate any impurities that may be mixed with it. When no more wax is detached, the berries are taken out with a ladle, aed fresh ones are put into the same water; observing to renew it entirely at the second or third time, and even to add boiling water in proportion as it evaporates, that the operation may not be impeded. When a certain quantity of wax has been thus collected, it is put to drain on a piece of linen, in order to separate from it the water with which it is still mixed. It is then dried and melted, strained a second time, to render it perfectly pure, and is made into cakes. Four pounds of berries yield about a pound of wax. That which is first detached is generally yellow; but in the latter boilings, the pellicle with which the stone of the berry is covered gives it a green tinge."

Kalm,

Kalm, the traveller, in speaking of vegetable wax, says, that in the country where the wax tree grows, they make excellent soap of it, which washes linen exquisitely white.

Such was the knowledge we possessed of the myrica, or at least no other observation had been published relative to it, to my knowledge, when a naturalist gave me half a kilo-gramme of the vegetable wax of Louisiana, I was curious to make a comparative analysis with it and bees wax: but before I undertook it, I wished to make myself acquainted with the tree and berry of the myrica. I saw that precious vegetable in the Garden of Plants, and I wrote to M. Deshayes, a studious botanist, who prosecutes the culture of the *myrica Pensylvanica*, at Rambouillet, requesting him to give me some details concerning it; he had the complaisance to answer me, and to send me some of the berries, which I immediately examined.

This berry is about the size of a pepper corn; its surface when ripe and fresh is white, having small black asperities, which give it a wrinkled appearance. When rubbed in the hands, it makes them greasy and unctuous.

If one of these small berries is rubbed hard a matter is shelled off, apparently of a starchy nature, and mixed with small round brown grains like fine gun-powder. The stone, which is left bare, has a very thick ligneous shell, and contains a kernel of the dicotyledon kind. By rubbing a handful of the berries on a hair sieve, I have obtained a grey dust, in which the eye can distinguish, without the assistance of a magnifier, the small brown grains above mentioned in the midst of a white powder.

I put this dust into alcohol, which, with a gentle heat, dissolved all the white part, and left the black powder which I collected separate. Water, poured on this solution

tion with alcohol, formed a precipitate, that rose and floated on the surface. I melted it and obtained a yellowish wax, similar to that from Louisiana, which had been sent me. This experiment is a sufficient proof that the wax of the myricæ is the white gritty matter that envelops the berry.

The black powder which I had separated appeared to me to contain a colouring principle; and I was in hopes of discovering in it the beautiful lake mentioned by M. Alexandre. Under this idea, I triturated this powder, and boiled it in a solution of acid sulphat of alumine; I was greatly astonished upon obtaining a liquor scarcely coloured at all, and in which the alumine precipitated by an alkali was only slightly tinged.

I took another part of this black triturated powder and put it to steep in alcohol. I soon obtained a dye of the colour of wine lees; I heated it, and it became as red as a strong quinquina or cachou liquor. This result made me imagine, that the colouring principle was resinous; but upon adding water I saw no signs of a precipitate.

I poured into this liquor water charged with sulphate of alumine; a slight precipitation ensued. A solution of sulphat of iron instantly turned it into ink.

What then is this colouring astringent principle, which is soluble only in alcohol, is not precipitated by water, and has so little attraction for alumine? To discover this would require a series of experiments, which the want of materials prevented me from undertaking. The astringent matter, noticed by M. Alexandre, must exist in the decoction of the whole berries. To ascertain this fact, I boiled some berries in a silver sauce-pan, the decoction, on which floated a small quantity of wax, was of a greenish colour; its taste was slightly astringent, and it precipitated ferruginous solutions, of a black colour.

I heated

I heated it in a very clean iron vessel, and it quickly turned black. To discover whether this property was owing to the gallic acid alone, or to the tanning principle, I mixed a small quantity of the decoction with a solution of glue, and no precipitate was formed.

It is therefore to the considerable quantity of gallic acid contained by the berries of the myrica that the property of curing dysenteries which its extract possesses, is owing. On this account, I think, that the leaves and bark of the tree would furnish an extract still more astringent than the berries.

The examination of the wax presents more interesting results.

Whether this wax be extracted by the decoction of the berries, or by the solution of the white dust in alcohol, precipitated by water, this melted wax is always of a yellow colour, inclining to green. Its consistence is harder than that of bees wax, it is dry, so friable as to be reduced to a powder; in short, it is evidently more highly oxygenated than the wax prepared by bees. Candles made with the wax of the myrica give a white flame, a clear light, no smoke, do not run, and exhale, if fresh, a balsamic odor, which the inhabitants of Louisiana consider extremely salubrious for the sick. When distilled in a retort, this wax passes over in great part like butter. That portion is whiter than it was; but it loses its consistence and has only that of tallow. Another portion is decomposed, furnishes a small quantity of water, sebacic acid and empyreumatic oil. Much carbonated hydrogen gas and carbonic acid gas is disengaged; a black bitumen, resembling charcoal, is left in the retort. Common wax acts in the same manner in distillation.

I have said above that alcohol dissolved the wax of the myrica; but ether dissolves it much better, and it sepa-

rates itself in the form of stalagmites in the evaporation of the liquid. Neither the one nor the other takes away its colour. If this wax is boiled in weak sulphuric acid, it becomes rather whiter; but there is no perceptible combination of the acid with it. Yellow bees wax, treated in the same way, does not change its colour.

Oxygenated muriatic acid perfectly bleaches both kinds of wax. Vegetable wax, however, retains its colour with most obstinacy.

Vegetable wax dissolves in ammoniac: the solution assumes a brown colour; part of the wax turns to soap. Volatile alkali has much less action on bees' wax. Both kinds of wax stirred violently in a boiling solution of caustic pot-ash become white and form a real soap, as Kalm the traveller has observed.

The whiteness which the wax acquires in this saponification is not a new phenomenon. M. Chaptal, in his process for bleaching by the vapour of alkaline leys, has proved that the colouring matter of vegetables yields to the action of alkalis. Some chemists attribute this effect to the direct combination of soda or pot-ash with the coloured extractive part; a combination which brings it into nearly a saponaceous state and renders it soluble.

I imagine that, in this operation, the alkali exercises on the oil or on the wax a double attraction, at first direct with the constituent principles of the oil, afterwards predisposing and favouring the combination of the atmospheric oxygen with oil or wax. I know not whether any person had the idea before me, but it was given me by the observation of what passes in the decomposition of soap by an acid: the oil is always concrete and more oxygenated than it was before. It would be interesting for the theory of chemistry to make soap if possible in a close apparatus, in which the air might be examined after the

the experiment, or in the different gases which contain no oxygen.

In decomposing the soap of myrica, a white wax is obtained, but in a particular state which does not admit of its being employed for our purposes.

Litharge or semi-vitreous oxyd of lead dissolves very well in melted Louisiana wax; it forms a very hard mass, but the consistence of which may be diminished at pleasure by the addition of a small quantity of oil. If, as there is reason to suppose, the wax of the myrica retains a portion of the astringent principle obtained by the decoction of the berries, the physicians will perhaps discover useful properties in topical applications composed of this wax.

Upon a retrospect of the preceding facts it will appear that the myrica may be rendered extremely useful to the arts. The wax which it yields is in sufficient quantity to compensate amply the care and expence of cultivation, since a tree in full bearing produces 6 or 7 lbs. of berries, from which may be extracted a fourth of that weight of wax. This wax is of a quality superior to that of bees' wax.

The astringent principle of the myrica, extracted on a large scale, might be very useful either in medicine or the arts: it might, in some measure, be substituted instead of the gall-nuts, in dye-houses, in the manufacture of hats, and even in tanning certain kinds of leather. The colouring principle appears sufficiently solid to deserve some attention; and, if it be true that a beautiful lake has been made from it in Louisiana, why cannot we likewise succeed in rendering it useful for painting? And when this wax becomes so common as to be sold at a low price, of what advantage will it not be for making soap?

T 2 The

The art of bleaching this wax requires a more perfect investigation for operating on a large scale and with œconomy. Two agents offer themselves to manufacturers: sulphuric acid and oxygenated muriatic acid. But, as the wax does not sink in those liquids, means must be employed for increasing the contact, either by putting the wax in shavings and sprinkling it with oxygenated muriatic acid, or by inclosing it in the same envelop in casks through which oxygenated muriatic gas may be passed.

I shall propose a third which promises a more expeditious effect. The wax, divided into very small pieces, is laid in strata in a cask, together with muriate of lime: they are thus disposed layer by layer, and left some time in contact in a dry state. The salt is afterwards decomposed with water acidulated with sulphuric acid, taking care to pour on the water at different intervals, till no more muriatic gas be perceptibly disengaged: then a considerable quantity of water must be added, and the mixture must be stirred with a stick. In standing the insoluble sulphur of lime is precipitated, and the bleached wax floats on the surface. It is then washed and melted in a balnea mariæ.

I shall conclude this memoir with some notices relative to the cultivation of the *myrica Pensylvanica*. M. Deshayes, to whom I am indebted for the opportunity of making my experiments, has for several years turned his attention to the wax-tree at Rambouillet. He writes me as follows on this subject.

" The myrica latifolia (Ayton) is perfectly at home here; the soil, which is a sandy and blackish loam, is exactly adapted to it: we have here 16 productive wax-trees. Their height is 4, 5, and 6 feet. There is one male tree of 7 feet. The berries are abundant almost every

every year; I say almost, because in some years there is a failure. In general they are very fine in the English part of the garden which is allotted to these plants.

"Their culture requires no particular attention. The numerous shoots from the foot of the large trees are every year taken off and planted in some other place at the distance of a metre from each other."

The berries may be sown in spring in beds, and afterwards transplanted; but this method is the longest. The myrica will thrive every where in a light and rather humid soil. How many provinces are there into which this useful branch of agriculture might be introduced, and where lands almost totally waste might be turned to advantage!

What benefits may not agriculture in general expect from such an acquisition, since the myrica has long flourished even in the arid sands of Prussia!

The French government has already given encouragement to this branch of industry by ordering plantations of the myrica. At Orleans and at Rambouillet there are two shrubberies of wax-trees, containing above 400 plants. Too much publicity cannot be given to circumstances like these; nothing is more tardily propagated than useful plants. A sterile but picturesque tree, an agreeable flower, are soon adopted by fashion. They ornament the paterres of our modern Luculluses, and the apartments of our Phrynes, whilst the indefatigable friends of agriculture vainly attempt to enrich our fields with a new grass, or to fill our granaries with nourishing vegetable productions.

New

New Method of expeditiously obtaining Nitric Ether by Distillation without external Heat.

By M. Brugnatelli.

From the Annali di Chimica.

INTO a tubulated retort is introduced one ounce of sugar, and two ounces of pure alcohol are poured upon it. To the retort is adapted a capacious receiver, envelopped with a cloth dipped in cold water, and the joinings are secured with a single slip of paper. Upon this matter three ounces of highly-concentrated and smoking nitric acid are poured through the tube of the retort. An effervescence instantly takes place, the mass becomes heated, the sugar is dissolved, ebullition ensues, and the alcohol is etherized, and passes from the retort into the receiver. Thus, in a little time, you may collect in the receiver all the alcohol converted into excellent ether, of a light orange colour, and a very agreeable smell; which does not turn vegetable blue dyes red, and acts in every respect like the best ether from nitric acid.

After the formation of the ether, a small quantity of nitrous gas is disengaged in this operation, which is discovered by a red vapour, which spreads through the apparatus. At this moment the receiver should be changed. In the retort is left some sugar, which may easily be converted into oxalic acid, by treating it with a fresh quantity of nitric acid.

The following is an explanation, according to my theory, of the phenomena which occur in this operation.

The thermoxygen, which nitric acid, to the exclusion of other acids, which are simply oxygenated, abundantly contains, is decomposed by the carbone of the alcohol, and disengages itself from the caloric by which the mass

is

is heated. The carbone of sugar afterwards continues to decompose the thermoxygen, and the whole mass is heated to the degree of ebullition. A portion of the undecomposed thermoxygen combines with the decarbonised alcohol, and forms ether. I have proved elsewhere, that ether is only alcohol decarbonised and thermoxygenated.

New Observations on the Conversion of fixed Oils into Wax.

By M. Brugnatelli.

From the Annali di Chimica.

It is a long time since I announced that fixed oils were susceptible of being thermoxygenated and oxygenated, and that the produce they afforded was different according as they had undergone one or the other operation. Oxygenated fixed oil changes to an acid, acquires a pungent smell and an acrid taste, and remains in a more or less liquid state. Thermoxygenated fixed oil is condensed, becomes opaque, loses all smell and colour, and approaches to the nature of wax. This phenomenon has not escaped the modern chemists, but they thought that it took place only with certain kinds of oils, and attributed both changes, however dissimilar, to the oxygen. To decide the question, I endeavoured to convert into wax such oils as are known to become rancid when exposed to the air. I have already announced that I converted olive oil into this substance, by means of water; but this experiment did not always succeed, on account of the mucilage contained in the oil, which, by being carbonised in the boiling liquid, decomposed the thermoxygen, and opposed the combination of that principle with

with the oil. Thermoxygenated muriatic acid did not always appear to produce the desired effect on account of the different quantity of the mucilage in the oil, which was to be burned. However, I succeeded in obtaining an invariable result by proceeding in the following manner.

On two parts of almost rancid olive oil I poured one part of alcohol, which floated on the oil, and then another part of nitric acid, which, passing through the alcohol, carried some of the latter along with it, and sunk to the bottom of the vessel. Soon after large bubbles of gas disengaged themselves from the matter, a gradually increasing effervescence took place, and the mixture became heated. The alcohol was converted into ether. The oil was thermoxygenated; and after growing cold, and standing undisturbed twelve hours, it was found changed into a yellowish white substance, coagulated in a single mass, insipid, without smell, and of the nature of wax. This experiment, made publicly in the school of the University, was several times repeated with the same success. It should, however, be observed, that when the acid and the alcohol are too highly concentrated, their action is so violent that the matter flies out of the vessel; but it is easy to prevent that accident.

I have likewise obtained wax by covering copper filings with oil, and then pouring on them nitric acid diluted, that too rapid and violent an effervescence might not be produced. The thermoxygen as it is formed combines with the metal and the oil. The former is thermoxydated, and is dissolved in the nitric acid, and the oil is converted into wax. When cold the matter is found covered with a cake of wax.

Transactions

Transactions of Societies for promoting useful Knowledge.

London.

Royal Society.

THE Society met for the first time in this session, on the 4th of November, when a paper on the humours of the eye, by Richard Chenevix, Esq. F. R. S. was read.

Mr. Chenevix has made his experiments chiefly upon the eyes of sheep. He describes the aqueous humour in these eyes as a clear transparent liquid, of the specific gravity of 10.090, water being taken as 10.000, at 60° Fahrenheit. It scarcely alters vegetable blues when fresh. It gives a slight coagulum by boiling, and precipitates tannin and the nitrate of silver. Mr. Chenevix considers it as composed of water, albumen, gelatine, and muriate of soda.

The crystalline humour in the eye of the sheep is of the specific gravity of 11.000. It is neither acid nor alkaline. It is almost wholly soluble in cold water. It gives an abundant precipitate with tannin; and is partly coagulated by heat. It contains no muriate of soda; and is composed, says Mr. Chenevix, of a larger portion of albumen and gelatine than the other humours, and of a smaller quantity of water.

The vitreous humour, freed from its capsules, was of the same specific gravity as the aqueous humour; and Mr. Chenevix could discover no difference in the chemical composition of these two bodies. Mr. Fourcroy mentions a phosphate as contained in the humours of the eye; but Mr. Chenevix could not, in any case, detect the presence of it, though he made use of delicate tests.

Mr. Chenevix had not an opportunity to make many experiments on the human eye, but as far as his researches

have gone, they show that the chemical composition of the humours in it is similar to that of the humours in the eye of the sheep. The specific gravity of the aqueous, and vitreous humours, he found to be 10.053, and that of the crystalline 10.790.

There is a remarkable difference between the ratios of the specific gravities in the different humours of the human eyes, and in those of the humours in the eye of the sheep, as is evident from estimation. Mr. Chenevix considers the humours of the eye, as achromatic in their effect; and conceives, that in the human eye, which is less than that of the sheep, the smaller density of the crystalline humour is designed by nature for the purpose of preserving the achromatic property.

The composition of the humours in the eyes of birds, Mr. Chenevix found to be analogous to that of the humours in the eyes of sheep; but what is remarkable in them is, that the crystalline humour is of less specific gravity than the vitreous humour.

No particular precaution is necessary in taking the specific gravity of the aqueous and vitreous humours, but as the crystalline humour is not of uniform density throughout, it ought to be preserved entire for examination. Mr. Chenevix found the weight of a very fresh sheep's crystalline to be 22 grains; and its whole specific gravity as before mentioned 11.000. But on paring it away towards the centre, till only 5½ grains remained, he found that their specific gravity was 22.151.

Mr. Chenevix concludes his paper by stating that, if any just analogies could be drawn between the properties of dead and living matter, some curious inferences might be obtained concerning the dependence of the formation of the cataract upon the coagulation of the albumen in the humours of the eye; and he seems to wish that some observations

servations were made concerning the relations of this disease to a gouty habit; as in this habit the coagulation might be supposed to depend upon a superabundance of phosphoric acid in the secretions.

The Bakerian Lecture, by William Hyde Wollaston, M. D. F. R. S. was read on the 11th of November. It consisted of observations on the quantity of horizontal refraction, and the method of measuring the dip at sea.

Dr. Wollaston notices Mr. Monge's memoir on the "mirage" observed in Egypt, as containing facts which fully agree with his own theory formerly published. From his observations on the degree of refraction produced by the air near the surface of the Thames, it appears that the variations derived from changes of temperature and moisture in the atmosphere, are by no means easily calculable; but that a practical correction may be obtained, which for nautical uses may supersede the necessity of such a calculation. Dr. Wollaston first observed an image of an oar at a distance of about a mile, which was evidently caused by refraction, and placing his eye near the water, the lower part of distant objects was hidden, as if by a curvature of the surface. This was at a time when a continuation of hot weather had been succeeded by a colder day, and the water was sensibly warmer than the atmosphere above it. He afterwards procured a telescope, with a plane speculum placed obliquely before its object glass, and provided with a micrometer, for measuring the angular depression of the image of a distant oar, or other oblique object; this was sometimes greatest when the object glass was within an inch or two of the water, and sometimes when at the height of a foot or two. The greatest angle observed was somewhat more than nine minutes, when the air was at 50°, and the water at 63°; in general the dryness of the air lessened the ef-

 fect,

fect, probably by producing evaporation, but sometimes the refraction was considerable notwithstanding the air was dry. Dr. Wollaston has observed but one instance which appeared to encourage the idea, that the solution of water in the atmosphere may diminish its refractive power.

In order to correct the error, to which nautical observations may be liable, from the depression of the apparent horizon, in consequence of such a refraction, or from its elevation in contrary circumstances, and at the same time to make a proper correction for the dip, Dr. Wollaston recommends, that the whole vertical angle between two opposite points of the horizon be measured by the back observations, either before or after taking an altitude; and that half its excess above 180° be taken for the dip: or if there be any doubt respecting the adjustment of the instrument, that it be reversed, so as to measure the angle below the horizon, and that one-fourth of the difference of the two angles, thus determined, be taken as extremely near to the true dip. It is indeed possible that the refraction may be somewhat different at different parts of the surface, but Dr. Wollaston is of opinion, that this can rarely happen, except in the neighbourhood of land.

On the 18th of November, a paper, by James Smithson, Esq. F. R. S. on the chemical analysis of some calamines, was read.

Much uncertainty has hitherto prevailed on the subject of the composition of calamines, the author was induced to carry on his researches by the hopes of obtaining a more certain knowledge of these ores; and he considers his results as fully proving the necessity for new investigations, and that the opinions which had been adopted concerning them were far removed from the truth. Mr. Smithson's

Smithson's experiments were made upon four different kinds of calamine: the calamine of Bleyberg, that of Somersetshire, that of Derbyshire, and the electrical calamine.

The calamine from Bleyberg was white, and had a stalactitical form; its specific gravity was 3,584. It became yellow under the blowpipe; and when exposed to the heat of the interior blue flame was gradually dissipated. It dissolved with effervescence in sulphuric acid, muriatic acid, and acetous acid. It lost by heat rather more than $\frac{1}{7}$ of its weight. It afforded oxide of zinc, carbonic acid, and water, in the proportion of 714, 135, and 151; there was besides found in it a minute portion of the carbonates of lead and lime; but these the author considers as accidentally mixed with the ore, and not in combination with the other ingredients.

The calamine from Somersetshire was of a mamillated form. Its colour was brown externally, and greenish yellow internally: its specific gravity was 4,336. It dissolved in sulphuric acid, with effervescence: and when analyzed, by means of reagents, afforded in 1000 parts, 352 of carbonic acid, and 648 of oxide of zinc.

The Derbyshire calamine was in small crystals, of a pale yellow colour: their specific gravity was 4,333. When analyzed, by solution in sulphuric acid, and the action of heat, 1000 parts of them were found to contain, of carbonic acid 348, of oxide of zinc 652.

The electrical calamine, which Mr. Smithson examined, was from Regbania, in Hungary. It was in the form of regular crystals; the specific gravity of which was 3.434. They became electrical by heat: and when exposed to the flame of the blowpipe, decrepitated, and shone with a green light. The electrical calamine differs materially in composition from the other specimens, in being formed

chiefly

chiefly of quartz and oxide of zinc, which, according to the author, are in chemical union. 1000 parts of it gave 250 parts of quartz, 683 of oxide of zinc, and 44 of water; the loss being 23 parts.

From his series of experiments on the calamines, Mr. Smithson has been able to deduce, with a considerable degree of acuracy, the composition of sulphate of zinc; which, when free from combined water, he considers as composed of equal parts of sulphuric acid, and oxide of zinc.

In reasoning generally upon the constitution of the salts of zinc, Mr. Smithson offers some new observations in relation to affinity; and he thinks that the proximate constituent parts of bodies are not absolutely *united* in the remote relations to each other, usually indicated by analyses, but that they are universally very considerable parts of the compound, probably seldom less than .2. He applies this theory in accounting for the presence of water in the calamine of Bleyberg, in which there is not sufficient carbonic acid to saturate the oxide of zinc; and he considers this ore, as probably composed of a peculiar combination of water with the oxide of zinc, which he names hydrate of zinc, and of carbonate of zinc, to each other, in the proportions of 3 to 2.

All the calamines, when long exposed to the heat of the blowpipe, are dissipated, with the production of white flowers. This circumstance, the author thinks, ought not to be attributed to an immediate volatilization of the oxide of zinc; but rather to the deoxidation of this substance, by the charcoal and combustible matter of the flame, and the consequent immediate sublimation and combustion of the metallic zinc: to which combustion, the phosphorescence of calamines under the blowpipe may be owing.

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The fibrous form of the flowers of zinc, produced during the action of the blowpipe upon calamine, Mr. Smithson attributes to the crystallization taking place during their mechanical suspension in the air: and he thinks that the fluid state is not at all necessary to the production of crystals; and that the only requisite for this operation is a freedom of motion in the masses which tend to unite, allowing them to obey that sort of polarity which occasions them to present to each other the parts adapted to mutual union.

Smithfield Cattle and Sheep Society.

Friday morning, Dec. 10, the Stewards and Judges of this laudable Institution met at Mr. Wooton's Livery Stable-yard, Smithfield market, and minutely examined the several Oxen, Cows, Sheep, and Hogs, which had been sent in from different parts of England. A little after one o'clock the Judges returned, and affixed up a paper against each of the successful animals, specifying the particular prize it had obtained, and the name of its owner. The premiums were as follow:

Class I. For beasts fed on any kind of food except Corn, but not to have had cake before 1802.—1st prize, to the Owner of the best Ox or Steer of the weight of 160 stone or upwards, 25 guineas. This was adjudged to Mr. Westcar's Hereford black Ox—a very large and fine one.—2d prize, to the owner of the next best Ox or Steer of that weight, 13 guineas. This was adjudged to the Duke of Bedford's Hereford large dark red-coloured Ox.

II. For Beasts fed without cake or corn—1st prize, to the owner of the best Ox or Steer, of the weight of 100 stone or upwards, 25 guineas; this was adjudged to Mr. Westcar's Hereford large lightish red Ox.—2d prize, to the owner of the next best Ox or Steer, of that weight,

15 guineas. This was adjudged to Mr. Ladde's Lancashire red Ox.

III. For beasts fed without cake or corn—1st prize, to the owner of the best Ox or Steer, under the weight of 100 stone, 15 guineas. This was adjudged to the Duke of Bedford's French small cream-coloured Ox, there being no competitor.—2d prize, to the owner of the next best Ox or Steer, under that weight, 10 guineas. For this prize no Ox was offered.

IV. For Cows that have had three calves at least, and have calved in 1801 or 1802—1st Prize, to the owner of the best fat Cow, 15 guineas. This was adjudged to the Duke of Bedford's Devonshire small dark red Cow, there being no competitor.—2d prize, to the owner of the next best Cow, 10 guineas. For this prize no Cow was offered.

V. For long-woolled Wether Sheep, fed without corn or cake—1st prize, to the owner of the best pen of 3 two-years old long-woolled Wethers, of one man's breeding, 10 guineas. This was adjudged to Mr. Chandler's new Leicester Wethers—2d Prize, to the owner of the best pen of 3 one-year old long-wooled Wethers, of one man's breeding, 10 guineas. This was adjudged to Mr. Robinson's new Leicester Wethers.

VI. For short-woolled Wether Sheep, fed without corn or cake.—1st prize, to the owner of the best pen of 3 two-years old short-woolled Wethers, of one man's breeding, 10 guineas. This was adjudged to the Duke of Bedford's South Down Wethers—2d prize, to the owner of the best pen of 3 one-year old short-wooled Wethers, of one man's breeding, 10 guineas. The Judges seemed decidedly of opinion, that the Duke of Bedford's pen of South Down Wethers was better than the pen of the same breed of Sheep belonging to Mr. Elman,

man, but a law of the Society was supposed to prevent their adjudging both the Prizes of this class to his Grace, and the matter remains undecided.

VII. For Pigs—To the owner of the best fat Pig, 10 guineas. This was adjudged to Mr. Surrey's black and white Pig, of a mixture of the Suffolk and China breeds; it was fed at Edmonton Mills.

Monday, the shew of cattle continued as on Friday and Saturday, with the addition of Mr. Crace's two Hereford Oxen, two Cows, and ten Wiltshire Ewes; Mr. Joiner's two Hereford Oxen, and Mr. Johnson's Ox: and it was visited in the morning by a great concourse of persons. In the afternoon, about 120 persons sat down to dinner, at the Crown and Anchor, his Grace the Duke of Bedford in the Chair. After dinner, his Grace introduced the more immediate business of the day by thanking the Society for the honour they had done him in electing him their president, professing his inability to do justice to the situation without the able assistance of men of abilities round him, and promising his utmost exertions to forward the laudable views of the Society. His Grace lamented that the objects and views of the Society had been much mistaken and misrepresented; but he trusted that the public would in time see that their aim was, not the gratification of personal vanity or gain, but to increase the quantity of animal food, and the better supply of the markets therewith; that, if the progress already made had not answered the most sanguine expectations of the founders of the Society, much had been done; and he trusted they should continue to persevere, keeping the public good in view as the principal object. His Grace then read the report of the Judges on the prizes in the different classes; but his Grace remarked on the third and fourth classes, that the circumstance of there being

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only his Cow and Ox offered for these four premiums, arose from a misunderstanding of the day of shewing and the printed account of the premiums not being well circulated; he should not therefore think of accepting the premiums adjudged to him in these classes, but desired that they might be added to the funds of the Society. On reading the report on the sixth class, his Grace observed, that a doubt having arisen whether he could be entitled to both the prizes, Mr. Elman, the owner of the next best pen of South Down Wethers, had proposed, and it met with the entire approbation of the Judges and himself, that the prize of ten guineas for one-year old short-woolled Wethers should be given to Thomas French (his Grace's bailiff on the farm in Mould, where these sheep were bred). His Grace then stated, that the premiums for the year ensuing are to be the same as the present, except that the fifth and sixth classes are to be divided, and form four classes; the fifth, for long-woolled two-year old Wethers; the sixth, for long-woolled one-year old Wethers; the seventh, for short-woolled two-year old Wethers; and the eighth, for short-woolled one-year old Wethers. The ninth class, for Pigs, was varied, viz. first prize, to the owner of the best fat Pig, fifteen guineas; second prize, to the owner of the next best Pig, ten guineas. It is required that the weight of the Pigs shewn shall be certified when they were six, twelve, and eighteen months old, and also the quantity of food that they had eaten in each of the three intervals between the weighings: to be shewn at eighteen months old. An additional condition was made, that no beast shall obtain two prizes. His Grace then stated, that the candidates for prizes were to send in their cattle and sheep, next year, on Thursday the 15th of December; that the Judges were to be allowed the whole of the next day

day to examine them and the certificates, and prepare their report; and he concluded by again impressing on the Society that the end in view was public utility, to which all their efforts ought to be directed.

A paper was circulated at the table, containing proposals from his Grace the Duke of Bedford to purchase twenty lambs, of each of the different distinct breeds of this island, for the purpose of a decisive experiment of their comparative merits, by treating them all according to the method specified in the paper, till fit for the butcher. This noble experiment was planned by the late and much-lamented Duke; and we commend the present Duke's zeal and spirit for carrying it into effect. Another paper was circulated, containing Mr. Wakefield's proposals for premiums at his sheep-shearing, on the 25th of May, at Burnham, in Essex; and another, containing Lord Somerville's prizes for stock, to be shewn at Mr. Langhorn's yard in Barbican, on the Monday and Tuesday nearest the 1st of March in the next and ensuing years.—The utmost harmony and conviviality prevailed; and the company did not break up till a late hour.

The objects and tendency of this institution seem to have been much mistaken by the public, and during the late scarcity and high prices of meat, excessively *large and fat cattle* were among the causes artfully alleged as sources of the evil. It never was, we are assured, the object of this Society to encourage the excessive, much less the wasteful feeding of cattle in general, but merely to ascertain the particular breed of each sort of animal which will produce the greatest quantity of meat from a given quantity of its food: and it having been ascertained, by the experience of graziers and feeders of cattle, that such animals will, if continued at their food, become in time *excessively fat*; this extreme of the case,

or excessive fatness, has been therefore adopted by this Society, and we believe by most other judges on the subject, as a principal criterion of the most perfect animal for feeding, the shape, smallness of bone and offal; the fineness, length, and quantity of wool in sheep being points of inferior consideration; but not to be overlooked. As a proof also that the fault, if it exists, of keeping cattle beyond a proper period, is not encouraged by this Society, it had this year offered, to the graziers of all England, two prizes for oxen under the weight of 100 stone, and two others for fat cows, without limitation of weight; and yet only one ox and one cow were offered for these four premiums, and these both by one person! This extraordinary circumstance must, we apprehend, in part, have happened from the inadequate mode of publishing the premiums abovementioned. Considering the badness of the day, and the torrents of rain which fell at the time, the exhibition was very respectably attended. Among the well-known feeders of cattle, and encouragers of agriculture, were present, his Grace the Duke of Bedford, Lord Somerville, Lord William Russell, Mr. Arthur Young, Mr. Westcar, Mr. Elman, &c.

FRANCE.

Agricultural Society of the Department of the Seine.

At the public meeting on the second complementary day, the prefect of the department of the Seine opened the meeting by an address, in which he bestowed a just tribute of praise on the unceasing efforts of the Society since its institution, and notwithstanding the war, for the improvement of agriculture. He had seen, with the utmost satisfaction, that the zeal of the Society, seconded by the encouragement of government, had already been crowned with success.

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The President of the Society, M. Mathieu, likewise pronounced an address nearly to the same effect.

M. François de Neufchateau presented an analysis of the memoirs sent to the Society on the means proper for giving to the plough the highest degree of perfection. None of them answered the end proposed.

M. Chaptal, minister of the interior, promised to add 4000 francs to the 2000 already offered as the prize, the adjudication of which is postponed to the year 1804. There will be two inferior premiums of 1500 francs each; but the sum will not be paid to the author who shall have gained the first prize till the spring of the year 1805, and till trials, executed before the members of the Society in the department of the Seine, shall have confirmed the advantageous opinion produced by the discovery.

The details which M. François introduced on this subject favoured the idea, that ploughs should have higher wheels than they usually have; and that a plough with several shares appears preferable, according to the observations of some agricultural amateurs. He stated that memoirs may be written and sent in the principal languages of Europe.

M. Lasteyrie read a memoir on the economical properties of the birch tree.

M. Gregoire spoke of the public spirit which prevails in England, with regard to industry and agriculture. In the particular attention bestowed by proprietors on the cultivation of their lands, in the regard they pay to their tenants in the cleanliness of their habitations, in the monuments erected by gratitude, and lastly, in the encouragement granted by government, he discovered the sources of that public spirit which is so remarkable, and has such a happy influence, that agriculture is justly accounted

counted to have been brought to a higher degree of perfection in England than in any other country of Europe.

M. Silvestre, the secretary, made a report on the prizes for the years 1803 and 1804.

The sitting terminated with the distribution of three medals. One to M. Douet Richardot, for having drained a valley 1400 metres in length; another to Messrs. Lero and Roui, for improvements in wool; and the third to M. Poulet, for a method of dibbling corn, by which he produced one-third more in quantity, and saved $\frac{9}{10}$ of the seed.

Intelligence relating to Arts, Manufactures, &c.

Trial for alledged Infringement of Mr. TENNANT's *Patent* * *for a Bleaching Liquor. Before Lord* Ellenborough *and a Special Jury. Dec.* 23, 1802.

SEVERAL witnesses were called in support of the patent, who proved the great utility of the invention, and the general ignorance of the bleachers of it till after the date of Mr. Tennant's patent. On the contrary, a bleacher, near Nottingham, deposed that he had used the same means of preparing his bleaching-liquor for five or six years anterior to the date of the patent. He also stated, that he had kept his method a secret from all but

, and two servants concerned in pre-

;lasgow deposed, that, having had fre-
n with Mr. Tennant on the means of im-

ation of this patent see vol. IX. p. 303, of our

proving

proving bleaching-liquor, he had in one of them suggested to Mr. Tennant that he would probably attain his end by keeping the lime-water constantly agitated. Mr. Tennant afterwards informed the witness that this method had succeeded. These conversations took place in the year 1796; and Mr. Tennant obtained his patent in 1798. Upon this evidence the plaintiff was nonsuited.

Mine of Zinc Ore.

A mine of zinc ore, of very superior quality, has lately been discovered at Perranzabular, in Cornwall; it consists of 47 parts in 100 of zinc, when reduced to a metallic state, whereas the calx of iron contained in it is only 4 in 100.

List of Patents for Inventions, &c.

(Continued from Page 80.)

Thomas Barnett, of East-street, Lambeth, Surrey, Mathematical Instrument-maker; for an invention whereby a requisite quantity of air will introduce itself into any vessel containing fluids, or a superabundant quantity of air therein, discharge itself so as to preserve the fluid in a constant state for use.

Dated November 6, 1802.

Robert Walker, of Union-street, St. Mary-le-bone, Middlesex; for dining-ta
struction. Dated Novem

Henry Smith, Lieu
Navy; for an improved
and expeditious carriage
Dated November 13, 180

SIMON HUGUENIN, of Brook-street, Holborn, Middlesex; for a machine for accelerating motion with little friction, to be called the Universal Lever.
Dated November 13, 1802.

THOMAS MARTIN, of Brook-street, near Brentwood, Essex, Saddler; for a method of applying fire, by means of certain machinery, for the purpose of heating liquors, and applying such liquors when heated to various useful purposes. Dated November 20, 1802.

THOMAS DAWSON, of James-street, Long Acre, Middlesex, Tin Plate-worker; for a lamp or lanthorn, upon an improved construction. Dated November 25, 1802.

WILLIAM DOBSON, of St. Clement's Danes, Middlesex, Hardwareman; for machinery for the purpose of chasing away flies and venomous insects.
Dated November 25, 1802.

MARC ISAMBARD BRUNEL, of Gerard-street, Soho, Middlesex, Gentleman; for trimmings or borders of muslin, lawn, or cambric. Dated November 27, 1802.

JAMES ROBERTS, of Portsea, Hants, Mechanic, and EDWARD BRINE, of the same place, Coppersmith; for machinery for the purpose of dragging or locking the wheels of carriages of every description, and for instantaneously disengaging the horses therefrom.
Dated November 29, 1802.

ALEXANDER ROSS, of Bishopsgate-street, London, Perfumer; for gentlemen's peruqes or wigs.
Dated November 29, 1802.

DANIEL CRAANER, a native of Holland, but now residing in the city of London, Merchant; for a method of making verdigris in lumps or powder, with ingredients the produce of Great Britain, which will not only answer every purpose of foreign verdigris, but can be used as a water-colour upon paper, &c. Dated November 30, 1802.

THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

NUMBER IX. SECOND SERIES. FEB. 1, 1803.

Specification of the Patent granted to GEORGE HODSON, *of the City of Chester, Ash-manufacturer; for a new or improved Process or Processes for obtaining, preparing, or manufacturing, the Fossil or Mineral Alkali from various Substances.* Dated February 27, 1802.

With a Plate.

TO all to whom these presents shall come, &c. NOW KNOW YE, that I the said George Hodson, in compliance with the said proviso, do hereby declare that the nature of my said invention, and the manner in which the same is to be performed, is particularly described and ascertained in the following description, and in the drawing or section hereunto annexed, (see Plate IX. Fig. 2.); that is to say: I obtain, prepare, or manufacture, the fossil or mineral alkali from kelp, soda, the caput mortuums, produced from the use of salt-rock, common salt, brine, sea-

sea-water, from black ashes, nitron salts, produced from soapers' lye, from salt-rock, common salt, brine, sea-water, and soapers' spent-lye, in the following manner. In order to obtain the mineral alkali from the salt contained in kelp, I take about two hundred and a half weight of kelp, previously bruised or ground small, one hundred and a half weight of soapers' waste-ashes, and one hundred weight of tanners' waste-bark, and mix them well together. I then pour over them water, or soapers' spent-lye, sufficient to moisten the whole mass. In this state they are thrown into a reverberating-furnace, of the construction represented in the annexed drawing or section, or of any other construction, properly adapted to make the frame reverberate upon the materials which are thrown in by the entrance E, and spread regularly on the bottom of the furnace by means of an iron rake A, or any similar instrument. At intervals of about ten minutes the whole mass should be stirred, and the several parts thereof successively brought to the surface, that they may receive more strongly the action of the reverberating-flame: at every such interval two or three spades full of tanners' waste-bark, and two or three gallons of water, are thrown into the furnace, on the top of the materials, and regularly mixed with them. I pursue this process until about ten buckets of water and about three hundred weight of tanners' bark are introduced into the furnace. By this means the materials are preserved in a state resembling garden-soil. Throughout the whole operation a strong and regular heat is kept up, and in about four hours the materials will begin to flux on the top, and in five or six hours the whole mass will be fluxed. In this state, after it has been well stirred with the rake, it must be drawn out of the furnace, and when cold broken up for use. To obtain the mineral alkali from soda

soda and the caput mortuums before mentioned, or others of a similar nature, I proceed exactly in the same way as described above respecting kelp. To obtain the mineral alkali from the salt in black ashes, I take of them two hundred weight, first ground small, which I dissolve in water or soapers' spent-lye. I then take two hundred weight and a half of soapers' waste-ashes, and one hundred weight and a half of tanners' waste-bark, and mix them intimately together: they are then moistened throughout with the lixivium made of the black ashes, and thrown into the furnace. Afterwards I proceed, as in the case of kelp, excepting that I substitute this lixivium in the place of water, which is thrown into the furnace with the bark before each stirring of the materials until the whole lixivium is used. I then employ water, as described above with respect to kelp. I proceed precisely in the same way in obtaining the mineral alkali from natron, and also from salts produced from soapers' spent-lye, excepting that the lixivium in the latter instance is made with two hundred and a half instead of two hundred weight of the salts. To obtain the mineral alkali from salt rock and common salt, I take two hundred weight of either of them, and one hundred weight of black ashes, or the same quantity of salts obtained from soapers' spent-lye, I add the soapers' waste-ashes or lime, and the waste-bark, and then proceed exactly as I do with kelp. To obtain the mineral alkali from brine and sea-water, I evaporate them until they yield their salt; with one hundred weight of which I mix the same quantity of black ashes, or of salts produced from soapers' lye: I then add the soapers' waste-ashes, tanners' bark, water, or spent-lye, and proceed as with the kelp, &c. To obtain the mineral alkali from soapers' spent-lye, I evaporate

rate it until it is strongly impregnated with salt, and then proceed as with the lixivium made of black ashes. In each of these cases the process will take up about six hours. To improve kelp in the first manufacture of it, and so render it more fit for producing the mineral or fossil alkali, or for any of the uses to which kelp is applied, I intermix the ware or sea-weed with bean, pea, vetch, or any kind of straw, together with fern, furze, broom, with any other vegetable substances, all well dried previously to their being put in the kiln. In witness whereof, &c.

References to Fig. 2, Plate VIII.

A, the rake with which the substances are stirred.

B, bottom of the furnace.

C, the chimney.

D, the door of the fire-place.

E, the entrance through which the materials are put into the furnace.

F, the flue.

Length of the furnace eight feet. Height of the furnace nineteen inches. Width of the furnace forty-four inches. Width of the flue thirteen inches. Height of the flue fourteen inches.

Specification of the Patent granted to JOSEPH BRAMAH, *of Pimlico, Middlesex, Engineer; for Machinery for the Purpose of producing straight, smooth, and parallel Surfaces on Wood, and other Materials requiring Truth, in a Manner much more expeditious and perfect than can be performed by the Use of Axes, Saws, Planes, and other cutting Instruments, used by Hand, in the usual Way.*

Dated October 30, 1802.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said Joseph Bramah, do hereby declare, that the principal objects of my invention are as follows; that is to say, to shorten and reduce manual labour, and the consequent expenses which attend it, by producing the effects stated in my patent by the use of machinery, which may be worked by animal, elementary, or manual force; and which said effects are to produce straight, true, smooth, and parallel surfaces, in the preparation of all the component parts of work consisting of wood, ivory, horn, stone, metals, or any other sort of materials, or composition usually prepared, and render it *(them)* true and fit for use, by means of edge-tools of every description. I do not rest the merits of this my said invention on any novelty in the general principle of the machinery I employ, because the public benefit I propose will rather depend on new effects, produced by a new application of principles already known, and machinery already in use for other purposes, in various branches of British manufacture. This machinery, and the new manner of using it, with some improvements in the construction, together with sundry tools and appendages never in use before, are particularly described and explained hereunder.

I mean to use and apply for the purposes above stated every kind of edge-tool, or cutter, already known, either in their

their present shape, or with such variations and improvements as the variety of operations I may encounter may severally call for. But the tools instead of being applied by hand, as usual, I fix, as judgement may direct, on frames drove by machinery: some of which frames I move in a rotary direction round an upright shaft; and others having their shaft lying in a horizontal position, like a common lathe for turning wood, &c. In other instances I fix these tools, cutters, &c. on frames which slide in stationed grooves, or otherwise, and like the former calculated for connexion with, and to be driven by machinery, all of which are hereafter farther explained and particularized.

The principal points on which the merits of the invention rest are the following. First, I cause the materials meant to be wrought true and perfect, as above described, to slide into contact with the tool, instead of the tool being carried by the hand over the work, in the usual way.

Secondly, I make the tool, of whatsoever cutting kind it be, to traverse across the work in a square, or oblique direction; except in some cases, where it may be necessary to fix the tool or cutter in an immoveable station, and cause the work to fall in contact with it by a motion, confining it so to do, similar to the operations performed on a drawing-bench.

Thirdly, in some cases I use, instead of common saws, axes, planes, chissels, and other such instruments, usually applied by hand; cutters, knives, shaves, planes, and the like, variously, as the nature of the work may render necessary; some in form of bent-knives, spoke-shaves, or deep-cutting gauges, similar to those used by turners for cutting off the roughest part. I also apply planes of various shapes and construction, as the work may require, to follow the former in succession, under the same operation; and which latter I call finishers.

Fourthly,

Fourthly, these cutters, knives, &c. I fix on frames of wood, or metal, properly contrived for their reception, and from which they may be easily detached for the purpose of sharpening, and the like—these I call cutter-frames. These cutter-frames I move in cases like those on which the saws are fixed in a sawing-mill, and some times to reciprocate in a horizontal direction, confined and stationed, by grooves or otherwise, as may be found best calculated to answer the several works intended. In other instances, and which I apprehend will generally have the preference, I fix cutter-frames on a rotary upright shaft, turning on a step, and carrying the frame round in a direction similar to the upper mill-stone; and sometimes I cause the frames to turn on a horizontal shaft, just resembling the mandrel of a common turning lathe, or those machines used for cutting logwood, &c. for the dyers' uses. When these frames are mounted in any of the foregoing directions for cutting, planes, &c. are fixed so as to fall successionally *(successively)* in contact with the wood or other materials to be cut, so that the cutter or tool calculated to take the rough and hilly part operates the first, and those that follow must be so regulated as to reduce the material down to the line intended for the surface. These cutter-frames must also have the property of being regulated by a screw or otherwise, so as to approach nearer the work, or recede at pleasure, in order that a deeper or shallower cut may be taken at discretion, or that the machine may repeat its action without raising or depressing the materials on which they act. The manner of thus regulating the cutter-frames when on an upright shaft is particularly described below. These cutter-frames may be made of any magnitude and dimensions the work requires, only observing to make the diameter of those on the rotary plane so as to exceed twice the width of the materials to be cut, as the said materials

must

must slide so as to pass the shaft on which the cutter-frame revolves when on the upright principle.

Fifthly, when I use upright shafts, for the purpose of carrying the cutter-frame as above described, I do not mean that the lower end or point of such shafts shall come in contact with, or rest on, the bottom of the step or box in which they stand, neither do I mean that such said shafts shall rest or turn on any stationed unalterable point at rest, but the pivot or lower point of the shaft shall actually rest, and turn on a fluid body, such as oil, or any other fluid proper for that purpose, a considerable portion of which always to be kept between the lower point of the shaft and the bottom of the step in which it works. The said shafts may be either raised or depressed at pleasure to any required altitude, by means of a greater or less quantity of the said fluid being confined as aforesaid between the end of the shaft and the bottom of the step. This device * I deem of great consequence in the fabrication of all kinds of machinery where massy and heavy loaded upright shafts are used; and I perform it in the following manner; that is to say: The lower part of the shaft must be turned perfectly smooth and cylindrical to a height something above the greatest distance or length the shaft will ever be required to be raised or depressed when in use. This part of the shaft I immerse or drop into a hollow cylinder, which fits its circumference near enough to allow freedom of motion, but sufficiently fitted to prevent shake. This cylinder I call the step-cylinder, and *(which)* must be of a length nearly equal to that of the cylindrical part of the shaft above mentioned, so that when the point of the shaft rests on the bottom of the cylinder, the parallel or cylindrical part may be something above

* See Count de Thiville's specification, published in the fourteenth volume of the first series of this work, for the developement of a similar invention.

the

the top or upper end of the step-cylinder. In the upper end of this step-cylinder I make a stuffing-box, by means of a double-cupped leather or other materials surrounding the cylindrical part of the shaft, in such a way as will cause the junction, when the shaft is passed through it, to remain water-tight under any pressure that may be felt from the efforts of the fluid retained as before mentioned, to make its escape upwards through this part, *(which)* I have called the stuffing-box, when the shaft, with all its load, is passed through it, and immersed in the cylinder below. When this is done, the injecting-pipe of a small forcing pump, similar to those I use in my patent-press *, must form a junction with the step-cylinder in some part below the stuffing-box; then the pump being worked, the oil or other fluid injected by it, will by pressing in all directions, cause the shaft to be raised from its rest, on the bottom of the cylinder, and to be slided up through the stuffing-box just the same as the piston of my patent-press; and by this means the shaft, with all its incumbrance, and whatever may be its weight, may be raised to any given point at pleasure, and at the same time it will be left resting on the fluid under it, whatever the quantity or thickness of such fluid may be between its point and the bottom of the step-cylinder. By this means the shaft, with all its incumbent load as aforesaid, should it even amount to hundreds or thousands of tons, can be easily raised and depressed to any required point at pleasure, by the alternate injunction *(injection)* or discharge of the fluid used, exactly the same as performed by my patent-press as aforesaid; and at the same time all friction will be avoided except that of the stuffing-box, which will be comparatively trifling to that which would result from the resting of such a shaft on the bottom of the step,

* Published in the sixth volume, page 289, of the first series of this work.

in the usual way. Thus will be gained the properties above stated; and in addition thereto, I think it may be inferred, that, provided the stuffing-box is kept perfectly fluid-tight, such a shaft, thus buoyed up by and turning in a proper fluid, may continue working for years, or perhaps hundreds of years, without a fresh supply of oil, or whatever other fluid substance is found the most proper to apply.

Sixthly, the material that is to be cut and made true must be firmly fixed on a platform, or frame, made to slide with perfect truth, either on wheels or in groves, &c. similar to those frames in a saw-mill on which the timber is carried to the saws. These frames must be moved in a steady progressive manner, as the cutter-frame turns round either by the same power which moves the latter, or otherwise, as may be found to answer best in practice. This motion also must be under the power of a regulator; so that the motion of the sliding-frame may be properly adjusted according to the nature of the work. The motion of the cutter-frames must also be under the control of a regulator; so that the velocity of the tool in passing over the work may be made quicker or slower, as such work may respectively require, to cause the cutter to act properly, and to the best advantage.

Seventhly, I regulate the motions of both these parts of the apparatus, as aforementioned, by means of a new invention, which I call an universal regulator of velocity, and which is composed as follows; viz. I take any number of cog-wheels, of different diameters, with teeth, that will exactly fit each other through the whole, suppose ten, or any other number, but for example say ten, the smallest of which shall not exceed one inch in diameter, and the largest suppose ten inches in diameter, and all the rest to mount by regular gradations in their

 diameters

diameters from one to ten. I fix these ten wheels fast and immoveable, on an axis perfectly true, so as to form a cone of wheels. I then take ten other wheels, exactly the same in all respects as the former, and fix them on another axis, also perfectly true, and the wheels in conical gradation also; but these latter wheels I do not fix fast on their axis, like the former, but leave them all loose so as to turn upon the said axis, contrary to the former which are fixed. All these latter wheels I have the power of locking by a pin, or otherwise, so that I can at discretion lock or set fast any single wheel at pleasure. I then place the two axises *(axes)* parallel to each other, with the wheels which form the two cones, as above described, in reverse position, so that the large wheel at the one end of the cone may lock its teeth into the smallest one in the cone opposite, and likewise *vice versa.* Then suppose the axis on which the wheels are permanently fixed to be turned about, all the wheels on the other axis will be carried round with an equal velocity with the former, but their axis will not move. Then lock the largest wheel on the loose axis, and by turning about the fast *(fastened)* axis as before, it must make ten revolutions, while the opposite performs but one: then by unlocking the largest wheel and locking the smallest one at the contrary end of the cone in its stead, and turning as before, the fast *(fastened)* axis will then turn the opposite ten times while itself only revolves once. Thus the axes, or shafts, of these cones, or conical combination of wheels, may turn each other reciprocally, as one to ten, and as ten to one; which collectively produces a change in velocity under an uniform action of the primum mobile, as ten to a hundred; for when the small wheel on the loose axis is locked, and the fast one makes ten revolutions, the former will make one hundred.

And by adding to the number of those wheels and extending the cones, which may be done *ad infinitum*, velocity may be likewise infinitely varied by this simple contrivance—A may turn B with a speed equal to thousands or millions of times its own motion; and by changing a pin and locking a different wheel, as above described, B will turn A in the same proportion, and their power will *(be) transferred to each, in proportion as their velocities, reciprocally.* Here is then an universal regulator at once for both power and velocity. In some instances I produce a like effect by the same necessary number of wheels, made to correspond in conical order, but instead of being all constantly mounted on the axisis *(axes)* or shafts, as above described, they will, reciprocally *(be)* changed from one axis to the other in single pairs, match according to the speed or power wanted, just as in the former instance. This method will have in all respects the same effect, but not so convenient as when the wheels are all fixed, &c.

Eighthly, when spherical surfaces are to be produced perfectly true, and parallel to their centres in all directions, I use a tool, or cutter, of a proper shape, according to the nature of the materials to be cut. This tool must be fixed on a cutter-frame, fastened to the rest of any common lathe, so as to present its point exactly to a line drawn through the centre of the mandrel of the lathe horizontally, and the said frame on which the cutter is fixed must have the capacity of drawing out, at pleasure, to any required distance, to accommodate the diameter of the sphere to be cut or turned true. This cutter-frame must be likewise made to turn upon a centre or pin, very firm, and steadily fixed on the rest above mentioned, so as to enable the cutter to be turned by its frame round a centre exactly perpendicular to the centre of the lathe or line, before mentioned, by which the altitude of the tool's point

is

is to be regulated; when this is done and the wood, or other materials fixed on the lathe in the usual way, the cutter-frame must be drawn nearer, or farther distant from the centre on which it turns, to accommodate the diameter, just the same as the common rest. If the materials be rough, and require to be reduced to a spherical form by gradations, the work may be repeatedly gone over by the cutter, before it reaches the diameter proposed. By this simple apparatus the difficulty of turning perfect spheres is overcome; as it must be obvious to any person of the most ordinary capacity in mechanics, that while the work is turning in the lathe in a vertical direction, and the tool or cutter is by the hand, or otherwise turned, at the same time, in a perfect horizontal direction, round a centre, opposite to the actual centre of the sphere, the point of the tool or cutter must, of necessity, generate or turn a perfect sphere true in all directions without the smallest attention or assistance from the use of the instrument. I mention here the application of the cutter-frame to a common lathe, conceiving it will, by such an explanation, be more familiarly understood without a drawing; but, by this method, spheres of any practical magnitude may be cut with perfect ease and certainty.

Ninthly, when concave surfaces are to be produced, perfectly true, smooth, and parallel to their respective spherical centres, the work is fixed on a machine the same in all respects as the common turning lathe, as in the instance last referred to: I then fix a tool or cutter on a centre, exactly in a line, both perpendicular to, and on a level with the exact centre of the shaft or mandrel on which the work revolves; and which cutter or tool projects to the required radial distance with its point, so that when the work goes round by the revolution of the lathe, the tool or cutter at the same time revolving round its centre, a spherical concave will be generated

generated and produced by the fluction * of its point, as in the instance of the convex sphere.

Tenthly, I convert solid wood, or other materials, into a thin concave shell, similar to a dish. I cut them alternately out of each other, beginning at the smallest, by means of another tool or cutter, likewise moving on a stationed centre, as before, exactly on a level with, and perpendicularly true with the centre of the mandrel or shaft of the machine on which the work is fixed. This tool, or cutter, is made at its exterior point, or cutting end, of such a shape as best suits the nature of the work; and its shank, or stem is bent to the exact circle the concave is meant to be: it is then fixed on an arm or frame calculated to receive others of different circles, according to the work; in fact the same frame may be used which is above described to hold the tool for cutting spheres, either of the concave or convex kind. The tool must be fixed on this frame or arm, as above mentioned, at such a radial distance from the centre on which the frame or arm turns, so as to form a quadrant with one leg, turning on its centre, and the tool forming the periphery with its cutting point projecting to the line of the deficient leg. Before this tool begins its action, a common rest must be applied close to the face of the work, in order to support the tool when it begins its cut; and on which rest the tool will slide till its point proceeds under the controul of the centre on which its frame is fixed until it reaches the horizontal line of the lathe's centre, when the part cut off, or the inner dish, will fall from the stock, and leave the rest for the operation of another tool, of a larger circle. Thus the operation may be repeated till the whole lump is converted according to the intentions of the owner. Thus have I given the clearest description of my invention I am able. In witness whereof, &c.

* Compared with the record.

Specification

Fig. 1.

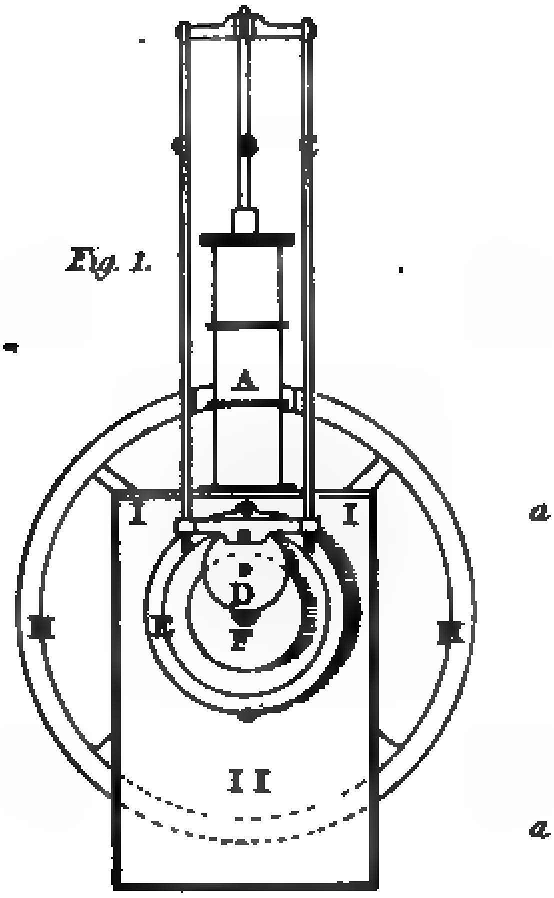


Fig. 5.

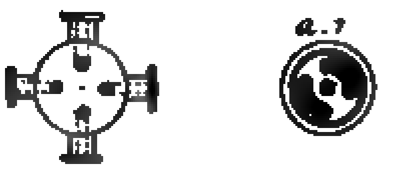


Fig. 6.

Fig. 7.

Fig. 8.

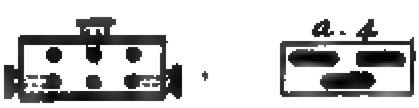
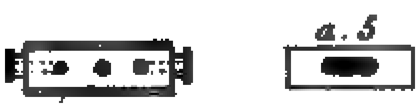


Fig. 9.



Specification of the Patent granted to MATTHEW MURRAY, *of Leeds, in the County of York, Engineer; for new combined Steam-Engines for producing a circular Power, and for certain Machinery thereunto belonging, applicable to the drawing of Coals, Ores, and all other Minerals, from Mines; and for spinning Cotton, Flax, Tow, and Wool, or for any Purpose requiring circular Power.*

Dated June 28, 1802. With a Plate.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said Matthew Murray do hereby declare that my said invention is described in manner following; that is to say: My new combined steam-engines, and parts thereunto belonging of my invention, are described in the figures and drawings hereunto annexed and explained. The letters refer to the same figures in all the drawings hereunto annexed and explained. Figs. 1, 2, 3, and 4 (Plate VIII.) represent front and side views, or sections, of the combination of parts constituting my new engine. A, the steam-cylinder. B, the piston-rod. C, C, connecting-rods, for connecting the piston-rod to pin in the wheel D. E, a wheel, fixed to the side of the cistern I I I I, with the teeth inwards, to admit the teeth of the wheel D, for the purpose of giving a parallel direction to the rods C, C. F, a plain wheel upon the fly-wheel-shaft G: the wheel F is furnished with a double conical centre for the wheel D to run upon, the principle and form of which is fully described in Fig. 10. H, is a fly-wheel, with a circular section of the rim, which I consider as a part of the invention. I I I I, is a cistern,

cistern, or frame of plates, on and in which the whole combination of materials constituting my engine is fixed, and part thereof inclosed by a door *a a*. K, K, two wheels, one upon the fly-wheel-shaft G, the other upon the crank-shaft L: these wheels and crank are for the purpose of working the lever R in Fig. 4, which lever gives immediate motion to the air-pump P, the cold water pump Q, and the hot water pump S. T, is an iron bar for supporting the crank-shaft L. M, is a slide-valve for opening and shutting the communication of the steam-pipes marked N, N, N, and is described in Figs. 5, 6, 7, 8, and 9: a motion for the slide-valve is taken from the crank-shaft L by levers, or otherwise, as the nature of the valve may require. O, O, in Fig. 4, are pump-pipes to the well, for drawing the water into cistern I I I I, in which the cold water pump is immersed. V, a pipe, for running off the spare water; the parts so combined form a perfect engine, without requiring any fixture of wood, or any other kind of framing than the ground it stands upon, and is transferable without being taken in pieces, (the motion of the fly-wheel shaft giving circular power to any process or manufactory requiring circular motion,) or for irrigating land, or for the various purposes of agriculture. Figs. 5, 6, 7, 8, and 9, represent various forms of my new slide-valve in its application to the steam-engine; the principle of which consists in moving in a circle part of a circle or straight line, by means of flat surfaces or faces (or nearly so), sliding or moving upon each other, for the purpose of uniting the necessary apertures in the steam-pipes or cylinders. Fig. 5, is a view of a circular flat sliding-valve; the dotted lines shew the avenues to the steam-pipes. *a* 1, is a figure representing the upper or moveable part of the slide-valve, Fig. 5, where the conducting or uniting cells

are

are formed. *a* 6, a circular spring, for compressing *a* 1 to the face of the slide-valve in Fig. 5, so as to render them perfectly steam and air tight; which perfection they will naturally acquire by constantly rubbing upon each other. *a* 7, a section of a box inclosing *a* 1, where the depth of the cell is shewn, and its connection with the face at the bottom of the box, the lid of which is not necessary but as a finishing to the valve-box. Figs. 6, 7, 8, and 9, shew four varieties of the slide-valve for working double and single powers. *a* 2, *a* 3, *a* 4, and *a* 5, contain the cells for conducting to the different apertures or steam-ways. *a* 8, the form of a lever or tappet for moving the slide-valves. *a* 9 and *a* 10, springs, with rollers, for pressing to the straight, or in part circular valves. Any farther description is unnecessary, as the drawings will convey to any one the principles of these inventions. Note. My new invention in this case consists in the application of one slide-valve, so contrived as to answer the purpose of the four valves, commonly used in double engines, or the two in single ones, and may be applied to engines of other constructions. Fig. 10, an enlarged view of the double conical centre and steel socket. *a* 11, the double-coned steel centre, screwed at both ends, one screw to fasten in the plane wheel F, represented in Figs. 1 and 2, where it acts as a crank for turning round the shaft G, the other end is screwed to receive a hollow cone, as represented. *a* 13, a nut, with two small screws, to prevent it from unscrewing. *a* 12, a section of the steel socket. *a* 14, plan of ditto. *a* 15, a square nut for the end of the steel conical pin. The invention and application of the conical pin to the wheel D, and connecting all the parts to the cistern, a frame of plates, as above described, constitutes the principle of this part of my invention. Note. The double-

 conical

conical pin may be applied to engines of other descriptions. Figs. 11 and 12, elevation and ground-plan of the above inventions and arrangements extended to two cylinders, forming a double engine, and may be used for the purpose of turning machinery, drawing coals or other minerals from mines. The parts marked with the same letters in this engine are the same as in the preceding one, with the addition of the two wheels marked *b*, *b*, for turning the fly-wheel H. X, X, X, are dotted lines, shewing the method of turning an upright shaft with an horizontal fly-wheel. *c c*, a hollow cylinder, with the sliding-drum upon it *d d*, around which two ropes are wrapped, to which two baskets or curves are suspended in the pit *f f*. *e e*, a screw, that goes into the hollow part of the cylinder *c c*, and is attached to the drum *d d* by means of a groove in the cylinder *c c*: when the fly-wheel H is turned round by the engine, the screw *e e* draws the sliding-drum *d d* along the cylinder alternately, and causes the ropes to be coiled on and off the drum *d d*, and prevents the coils from rubbing against, or wearing each other by lateral friction. One revolution of the screw must slide the drum rather more than the diameter of the rope. This method of the drum may be applied to beam-engines, or any other power for drawing coals, minerals, &c. My invention in this case consists in causing the drum to slide backwards and forwards, which prevents the destruction of the rope.

In witness whereof, &c.

Specification

Specification of the Patent granted to BENJAMIN DOUGLAS PERKINS, *of Leicester-square, London, Master of Arts; for the Art of relieving and curing a variety of Aches, Pains, and Diseases in the Animal Body, by drawing over the Parts affected, or those contiguous thereto, in certain Directions, various pointed Metals, and compounds of Metals, which, from the Affinity they have with the offending Matter, or from some other Cause, extract or draw out the same, and thus cure the Patient.*

Dated March 10, 1798.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Benjamin Douglas Perkins do hereby declare, that the said discovery is described as follows; that is to say: This invention or discovery consists in applying the influence of metals as a remedy in many diseases of the human body. The metallic substances which I employ for this purpose are those which produce that action on the nerves and muscles of animals, known by the term Galvanism. Among the metals that may be thus characterised, I have found none more eminently efficacious in removing diseases than the combinations of copper, zinc, and a small proportion of gold; a precise quantity of each not necessary: also iron, united to a very small proportion of silver and platina; an exact proportion of these also not necessary. These are constructed with points, and of such dimensions as convenience shall dictate. They may either be formed with one point, or pointed at each end, or with two or more points. The point of the instrument thus formed I apply to those parts of the body which are affected with diseases, and draw them off on the skin, to a considerable

distance from the complaint, and usually towards the extremities. The diseases most readily cured by this metallic influence are rheumatism, gout, pleurisy, inflammations, spasmodic affections, and most kinds of topical complaints. All parts of the body on which the metals are to be used, as well as the metals themselves, should be perfectly free from oily and greasy applications. The relief from this metallic application may usually be expected in the course of from fifteen to twenty minutes; but in obstinate chronic diseases their use should be continued a much longer time, and repeated two or three times in the day for several weeks. In witness whereof, &c.

On the Utility of Prussiate of Copper as a Pigment. *By* Charles Hatchett, *Esq. F. R. S.*

From the Journals of the Royal Institution of Great Britain.

THE accidental discovery made by Diesbach of the pigment called Berlin or Prussian blue, about the year 1710, and which afterwards was published by Woodward in the Philosophical Transactions for 1724, was soon adopted by artists and manufacturers, so that in a short time the great utility of this colour was completely established; it is therefore remarkable, that but little attention has been subsequently paid to the colorific properties of the other metallic prussiates.

The experiments made by Mr. Brown, with the prussic lixivium on various metallic solutions, do not merit particular attention, as the results evidently show that a very large portion of the alkali remained unsaturated with

with prussic acid, and thus the effects appeared different when the lixivium was prepared with blood or with muscle *.

Bergman has however more accurately examined the properties of metallic precipitates (Opuscula. Tom. 2, p. 385), and especially notices the various colours of the prussiates; but neither he, nor any other chemist, as far as I am acquainted, has pointed out to artists the utility of prussiate of copper as a pigment. During some late experiments, I was much struck with the beauty of this precipitate, and was therefore induced to make several trials of it as a paint; the results exceeded my most sanguine expectations. I afterwards prepared a large quantity, which, at my request, several gentlemen (particularly B. West, Esq. P. R. A. John Trumbull, Esq. and Sir H. C. Englefield) were so obliging to try in oil, and in water, and I have had the satisfaction to learn, that in beauty and intensity it surpasses every brown paint now in use, with the additional advantage, that, by reason of its purple tint, it forms, with white, various shades of bloom or lilac colour, which do not appear liable to fade like those which are formed by means of lake.

The prussiates obtained from acetite, sulphate, nitrate, and muriate of copper, are all very beautiful, but the finest and deepest colour is afforded by the muriate. I have found also that prussiate of lime can be better depended upon for this purpose than prussiate of potash. The best mode therefore of forming this pigment, is to take green muriate of copper, diluted with about ten parts of distilled or rain water, and to pour in prussiate of lime until the whole is precipitated; the prussiate of copper is then to be well washed with cold water on the filter, and to be dried without heat.

* Phil. Trans. 1724, p. 17.

Description

Description of an improved Mill for grinding hard Substances; invented by Mr. GARNETT TERRY, *of the City Road, Finsbury-square.* With a Plate.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

The Silver Medal was adjudged to Mr. TERRY *for this Invention.*

THIS mill is calculated for the purpose of grinding hard substances. One has been made on a large scale, which reduces to powder coffee, bones, ashes, and other such things: it has also been tried, and found effectual and expeditious in breaking down beans, peas, malt, barley, &c.

A, (Fig. 1, Plate IX.) the hopper, or receptacle of the articles which are intended to be ground.

B, a spiral wire, in the form of a reversed cone, to regulate the delivery of them.

C, an inclined iron plate, hung upon a pin on its higher end: the lower end rests on the grooved axis D, and agitates the wire B.

D, the grooved axis, or grinding cylinder, which acts against the channelled iron plate E.

F, a screw on the side of the mill, by means of which the iron plate E is brought nearer to, or removed farther from, the axis D, according as the article is wanted finer or coarser.

G, the handle, by which motion is given to the axis.

H, the tube whence the articles, when ground, are received.

N.B. The front of the mill is taken off, in order to show its interior construction.

Fig 2 Page 161.

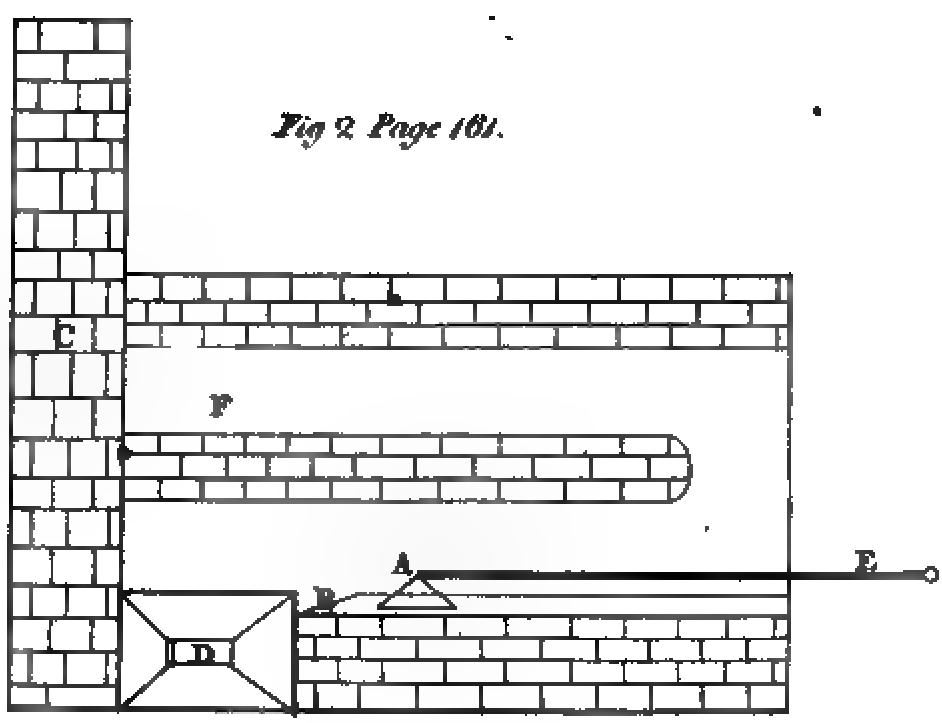
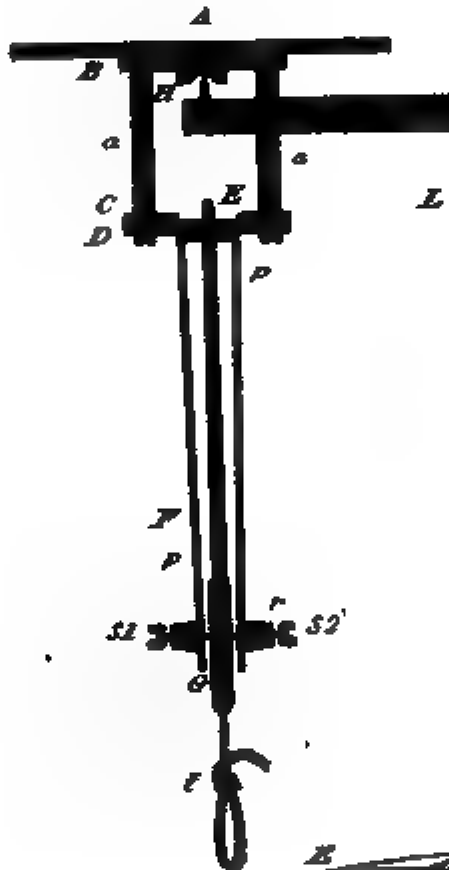


Fig. 1.

Fig 2
Half Size



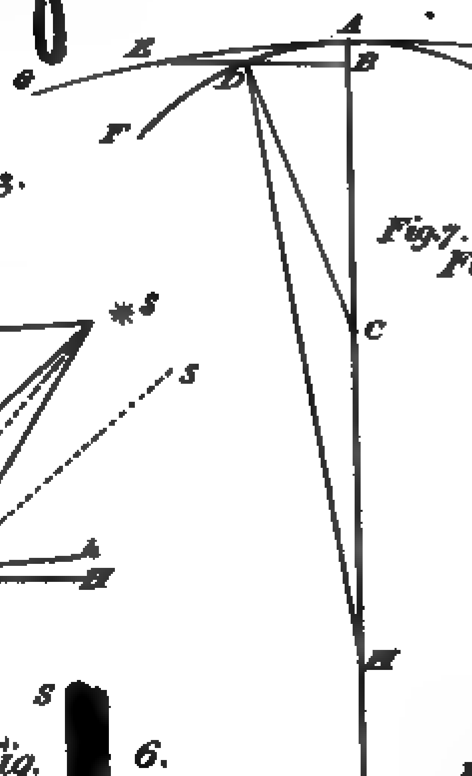


Fig. 7.

Fig. 3.

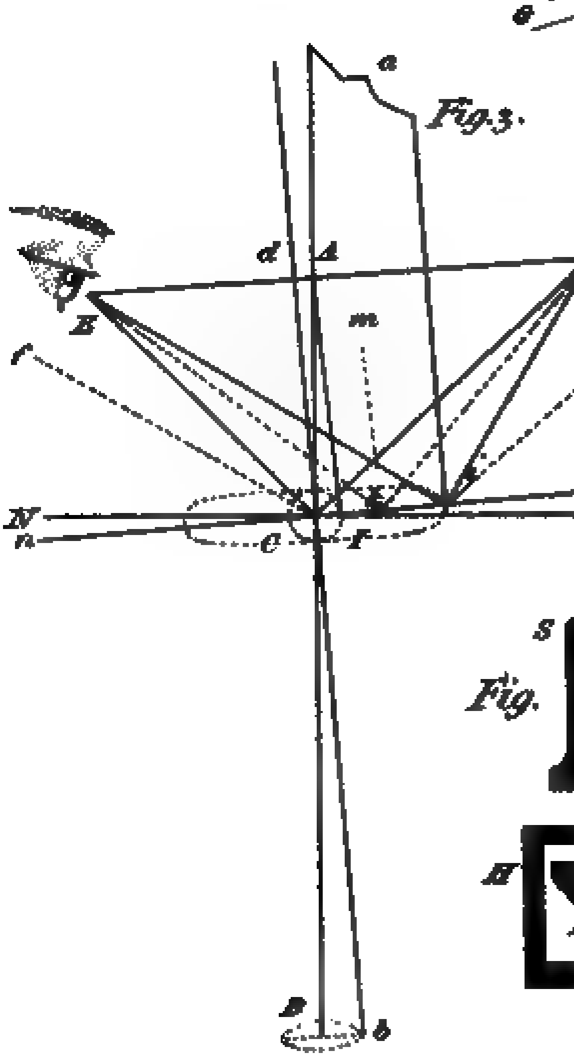


Fig. 4.

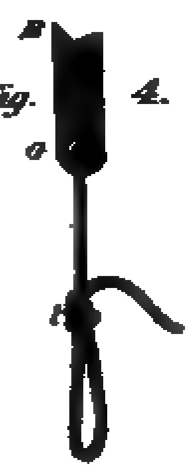
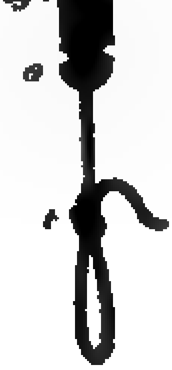


Fig. 6.

Fig. 5



Description of a Reflecting Level or an Artificial Horizon, for taking Altitudes of the Celestial Bodies, &c. on Land by Hadley's Quadrant; with some Remarks on different Levels. By the Reverend JAMES LITTLE.

With a Plate.

From the TRANSACTIONS of the ROYAL IRISH ACADEMY.

THE usefulness at sea of that excellent instrument, the Hadley's quadrant, is known to every navigator, it being the only one by which, without any stand or fixed position, and even when the observer is in motion, accurate observations can be made of the altitudes of the celestial bodies and their angular distances in order to find the longitude; and it would also, as being the most accurate and ready of all small and portable instruments of that nature, be exceedingly useful at land, especially to a traveller, in taking cursory observations, to discover the latitude, &c. of places occasionally visited, if it were furnished with an artificial horizon or level to supply the place of that natural one which at sea the water around the observer affords, and from which the altitudes of the celestial bodies are measured: for want of such a level on land, they who make observations with an Hadley's quadrant, which is not fixed and adjusted by a plummet or spirit-level, are obliged to take these altitudes by measuring the angular distance between the object and the image of the same seen on the smooth and level surface of a stagnant fluid, as water, quicksilver, &c.; and when the object is very remote, that angular distance will be double its elevation above the real horizon. But as such observations must be made in the open air, and the least breath

breath of wind will ruffle the surface of the fluid, it is necessary to cover it with two glass planes, joined at their upper edges, and erected like the roof of a house over the vessel containing the fluid; each of these planes must have its opposite surfaces exactly parallel, which is never the case with plates of looking-glass, and the proper planes with the requisite apparatus are in few places to be procured, and liable to accidental injury. Instead of this fluid artificial horizon I have used the following one, which can any where be easily made, and which I found to answer well, as being accurate and portable, less liable to accidents in travelling than the former, and discovering in the act of observation its own errors of adjustment. I constructed it in the two forms hereafter described, the first of which is represented in a perspective view in Fig. 1, (Plate X), and in a section through the middle in Fig. 2: the second form appears in Fig. 8, in a like section through the common axis of its parts.

It consists of a circular plate of glass A, (made of a piece of looking-glass) whose upper surface is plane and polished, but the under surface has its polish taken away by being rubbed with a piece of lead and flour of emery with water, so that an image of any object can appear by reflection from its upper surface only: to this is cemented, with black sealing-wax, the frame B C, (made of steel, or it might be of brass,) both having been previously made very clean and bright, heated in an oven, and then cooled slowly: this frame is composed of the round plates B and C fastened together by the two rods or pillars *a*, *a*, strongly rivetted or brazed to both plates: the piece D E, F is composed of the round plate D, which is exactly fitted and screwed close and immoveable by two screws to the plate C, so that both may be parallel to A and B. In the middle of the plate D is brazed the

pipe

pipe *p p*: this pipe is made of steel, and its sides as thin and light as may be consistent with strength to secure it from being easily bent; it tapers a little towards its end, and its mean external diameter is about $\frac{3}{13}$ of an inch: in the middle of this pipe is a steel-wire hardened towards the lower end, and tapering upwards towards E, where it is screwed (loosely) through the middle of a short pin or plate fastened in the mouth of the pipe, which pipe is (for strength) inserted quite through the plate D. The lower end of the wire, which extends a little below the pipe, has a hole through it at G at right angles to its axis, as represented (enlarged) in Fig. 4, and also in Fig. 5, in another section of the wire which is at right angles to the section in Fig. 4: this hole is to contain the knot of a looped thread *t*, which is inserted through a very small perforation made in the axis of the wire, and only so wide as just to admit the thread tight through it, or instead thereof a very fine and flexible string of cat-gut or fiddle-string, in order that when a weight is appended to the string it may pull the wire only by a point in its axis. A ring or hoop *r r* (of iron) is brazed on the lower end of the pipe *p p*, just so broad as to admit four equidistant and opposite adjusting screws *s s* (made of tempered steel, and having square heads, in order to be turned by a key as well as by a turn-screw) to be inserted through it; and the hoop is to be so thick as to sustain, without change of its circular shape, the pressure of the screws against the wire G E. The pipe *p p* is to be fixed perpendicular in the plate D, that it, and also the wire E G, when in the middle of it, may be at right angles to the mirror; and then any little deviation of the wire from this will be corrected by moving the wire (which must be so fixed as to yield easily) towards that side where it makes too great an angle with the mirror, which is done

by first withdrawing the adjusting screw on the same side, and then advancing the opposite screw: and when the wire is thus firmly pressed by the four opposite screws it cannot change its position after being made vertical to the mirror, nor consequently the instrument alter its adjustment *.

* The plate D might be omitted, and the pipe with the wire E G might be fastened in the plate C, were it not that there should be a hole left in the middle of this plate to allow the needle-cap (hereafter mentioned) to be fixed in the plate B, and if made of steel, to be polished anew, should it ever contract rust; to prevent which, it would be best to keep always a drop of oil in it. The wire should be so thick at the place of the screws that its diameter may be only about $\frac{1}{12}$ of an inch less than the internal diameter of the pipe; and, when the instrument is adjusted, the wire should be as nearly as possible in the middle of the pipe; for, if it were removed too much to one side, each pair of the screws, whose ends are all equidistant from one another, would not press the wire in points of it diametrically opposite; in which case the withdrawing of one screw alone might not permit the motion of the wire to that side, but it might be requisite to ease two contiguous ones, and create a necessity for altering all the screws, which would render the adjustment very troublesome. This will be avoided by making the wire as thick as it may conveniently be, just at the place of the screws, and by having the pipe fixed at right angles to the mirror.

Another method of appending the weight to the stem is represented enlarged in Fig. 6. The lower part of the stem is formed as at S T, and a pin P, made of hardened steel, is screwed into it, in whose end is a conical cavity with a fine apex to receive the fine and hard point of a hook H, made of a thin plate of steel, and fashioned as in the figure: through a hole in the hook at *h* a string is put to sustain the weight, which it is plain will thus pull the stem only by that point in its axis which is the vertex of the conical cavity. Whether this or the above method of suspending the weight is the best I cannot say, though I have tried both; but would rather recommend the former, as being more simple, and consequently fitter for a portable instrument, which should consist of as few parts and common materials as possible, lest any should be lost, deranged, or damaged. I made trial of a small ring (to hang the weight from) passed through the end of the stem, which was made thin, but it would not answer.

In

In making this little instrument, care must be taken to form it so, that when the frame B C, and its appendages D F, are screwed together, then the common axis A G of the whole shall pass through the centre of the plate A, and be at right angles to its plane; for, when this is the case, if it be contrived to sustain the axis A G in a vertical position, the plate A will be kept in an horizontal one, and will be a reflecting level: this is effected by suspending the whole from a point N, (Fig. 2,) in the axis, as near the plate A as can be, and hanging from the looped string *t*, by a hook, a weight to swing in a vessel of water, or in the air, if it be calm enough. The point of suspension is in the axis of a pin of steel H'* (tempered very hard) inserted through, and fixed in the plate B, having a conical cavity in it, whose apex is polished, to receive the point of a strong and hard-tempered steel needle N, which needle supports the instrument, and is itself sustained perpendicularly in an iron arm K, rivetted in the plate M, by which it is fastened by the screw L on the inside of a vessel or case about eight inches deep and near three inches wide internally: the arm K has such a length and position as that the needle N shall be in the middle of the vessel: this vessel is to rest or be sustained steady on some stand, or to be steadily fastened by a screw, in an upright situation, to a firm door-post, tree, or wall, &c.: when the vessel is vertical its upper edges must be level, and the arm K must be placed so high as that the upper surface of the plate or mirror shall be very little higher than the edges of the vessel: the lower part of the vessel is to hold water sufficient to cover the weight, and the upper part is to have a door in the side

* A strong agate needle-cap, such as is used for compass-needles, and fixed in the plate B, would answer best.

 to

to allow the instrument to be suspended, and its weight hung by a hook from the loop of the thread *t*, or its vibrations to be stopped; for which purposes the door should descend to near the surface of the water: it is to be shut at other times to prevent the wind from agitating the level.

From this description it is evident, that when the instrument is suspended from the point N, under the centre of the mirror, and the weight appended to G, or the middle point of the hole in the axis of the wire, these two points would be always in the line of the direction of gravity if the instrument itself had no weight, or if that line passed through the centre of gravity of the whole machine; but if the glass plate and metal frame could be divided into two parts, of unequal weight, by a plane passing in any direction through A G, then the axis A G would be thrown out of the direction of gravity, and consequently the mirror out of the level more or less as the weight appended at G is less or more: this can scarce happen if the point of suspension N be in the centre of the plates A and B, each of the plates B, C, and D, be of uniform thickness, the pillars *a*, *a*, of equal size, equidistant from N, diametrically opposite and at right angles to the plates B and C, and the stem E F, in the middle of the plate D, and perpendicular to it; and thus the line A G be the vertical axis of the whole, and of each of the parts: this easily may, and must at first be nearly effected; which will be known in some measure by the plate A resting level when the instrument is suspended on the needle N without any weight hung from the end of the stem; and if it could be effected accurately, there would be no use for the pipe *p p*, and a solid stem E F might be fixed in the plate D; but when the weight is hung from the stem, and the instrument receives a circu-

lar

lar motion round the plumb-line, (which certainly may be considered the same as A G,) it will be found that the image of a fixed object seen by reflection in the mirror, by an eye kept also fixed or viewing it through a fixed sight or vane, will not, during the motion of the instrument, appear every where at the same distance from the centre or edges of the circular plate or mirror, but the image will move or shift its place in it; a certain proof that this was not horizontal, and that though the line A G is insensibly different from the line of gravity, yet that it was scarce possible to fix that line at right angles to the plate, but that there was a necessity for adjustment: for this purpose, therefore, the four adjusting screws *s s* were added, whose mode of action and effect have been explained.

If, during almost half a revolution of the mirror round the axis N G, (which motion the arm K, being made purposely thin and the pillars *a a* small, will allow) the reflected image of a fixed object seen as above mentioned appears also fixed, the mirror is as perfectly horizontal as the plumb-line is vertical; supposing the surface of the mirror to be a true plane (and one must be unlucky indeed in the choice of a piece of looking-glass if it be not sufficiently so); and as it can by the adjusting-screws be regulated to as much precision as the eye, even assisted by a telescope, can ascertain the contact of two images, and also proves its own adjustment, (by turning it round on its axis,) which can be farther verified by comparing angles taken by reflection from it with those taken from the surface of a fluid; also as it does not seem likely to change its form after being adjusted, and the screws made firm; it seems in this respect unexceptionable, and it may be adjusted the way before mentioned by observing the image of any fixed object, as the sun or

moon,

moon, the top of a mountain or building, a candle placed at the distance of ten or fifteen feet, a wafer fastened on the glass-pane of a window, &c. if when the mirror is made to revolve round the axis A G, without any pendulous vibration of the weight, the image *first ascends* towards the part of the mirror most remote from the eye, and *then descends*, that part of the mirror in which the image is seen most elevated or culminating, also ascends or is raised above the level; and it will be lowered by first unscrewing a little the adjusting-screw, which is nearest to the most elevated place of the image on the same side, and then screwing up the opposite screw; for this will make the end of the stem approach towards, or make a less angle with the mirror on the side where that angle was too great, *i. e.* where the mirror was too much elevated: also if the image, during the revolution of the mirror, appears *first to descend* towards the observer, and *then to ascend*, that part of the mirror in which the image is lowest, is too much elevated above the horizon, and it will be depressed by withdrawing the screw next to the lowest place of the image, (which is now the highest part of the mirror,) and advancing the opposite screw as before; so that the adjuster must be cautious not to mistake *the order* of the ascent and descent of the image, nor the *direction* of its *motion;* for as it has (in every complete revolution) both an ascent and descent towards and from the highest and lowest points, if the observer mistakes the one for the other he may move the screws erroneously, so that he must previously ascertain the highest and lowest place of the image.

That it is by the elevation of the mirror on the side in which the image appears it is made to ascend, may be ocularly demonstrated by giving that diameter of the mirror, which is in the same plane of reflection with the eye,

eye, the object, and image, an angular motion in that plane upon the point of suspension; but if one would choose to know the optical reason of this effect, and of the preceding directions, (and the knowledge of the theory of any instrument enables the reader to appreciate its merits, and also precludes injudicious attempts at alteration or improvement; on which accounts I think the theory should accompany the description of every machine), he may understand it from considering the following circumstances; and indeed since differences in the distances of the near objects, by which alone this mirror, when not level, could sometimes be adjusted*, will produce a variety of motions and places of the reflected image, while the mirror is turned round the plumb-line, even when the altitude of the objects does not vary; and *vice versa*, differences in the altitudes when the distances are unvaried; which might puzzle and disgust the person adjusting it, and create doubts of its accuracy, it is the more necessary to give some explanation of its optical properties when it is proposed for use.

* Though the want of adjustment of this level may be discovered in every observation of the celestial bodies, in which case their great distance renders the place of the eye, and consequently of the quadrant used, immaterial; yet it can scarcely be adjusted by an observation of the sun, &c. unless they are very near the meridian, when there might not be time enough to accomplish it, and also unless the altitude of the sun, &c. be not too great: therefore the sun will not answer well for adjusting it in low latitudes, nor the moon except when at full: it will on these accounts be most generally convenient to adjust it by a near object, in which case the eye must be fixed, and then there will be a greater variety in the motions of the reflected image on the mirror, according to the relative distances of the eye, and object from it; and there should be an attention to minute circumstances in the process of adjustment: wherefore I thought it proper to give some account of these particulars.

In

In Fig. 3, let the line C B represent the stem of the level, kept by the plummet in a vertical situation: if the instrument were truly adjusted, C B would be the axis of the mirror, and at right angles to its reflecting surface; but if it be inclined to this surface, then no diameter drawn on it will be at right angles to C B but one; all others will be inclined to it in various angles of obliquity, the greatest being that at right angles to the diameter which has no inclination; and if the mirror revolve round the line C B, this latter diameter will describe a circle, but the others intermediate between these two will describe opposite conical surfaces, having all of them different angles at their common vertex C. Let H N be that diameter at right angles to C B the plumb-line, and consequently in the horizon, and let it be in that plane in which the eye, fixed at the place E, sees the image of a luminous point S in the point C: from the law of reflection, the angle S C H, made by the incident ray S C with the mirror, must be equal to E C N, made by the reflected ray C E with the same; let now the mirror revolve about the axis C B till another diameter, suppose that which is most inclined to C B, *viz.* *h n*, falls into the plane of vision or reflection S H C E; the image of S cannot now be seen at C, because the angle S C *h* is not equal to the angle E C *n*, and it can be seen only in a part of the mirror where these angles, at the point of incidence, will be equal, and that will be (when the object is very remote) at a point *i*, whose angular distance C E *i* from the point C is equal to twice H C *h* the obliquity of the speculum *, or because the angle made by two

* When the object S is so distant that the angle C S *i* is evanescent, the ray S *i* will fall on the mirror in the same direction as S C, that is, in S *i* parallel to S C: when the ray fell at C on the diameter H N, the

two lines or planes is equal to that made by two perpendiculars to the same, if C *b* be perpendicular to *h* C, it will

the angle of incidence was S C A, but in the change of the reflecting plane H C to *h* C, that angle receives an increment H C *h* equal to B C *b*, and the angle of reflection must receive the same; so that the angular velocity of the reflected ray is double that of the speculum; and hence, if the angle E C *f* be made equal to twice B C *b*, C *f* will be the reflected ray, and if the eye were at *f*, it would see the image at C, but the eye remaining at E will see it at *i*, in a direction parallel to *f* C, and at an angular distance C E *i* equal to E C *f*, from the point C; because there the angles of incidence and reflection S *i a*, E *i a* are equal, being the same as S C *d*, *f* C *d*. But if the object S be so near that the angle C S *i* or *s i* S is of a sensible magnitude, then the incidence S *i a* is less than it was before, by the quantity of this angle, and the angle of reflection E *i a* must be equally diminished, or both receive equal and contrary alteration, which will be when the image is formed at that point *k*, between *i* and C, where the angles of incidence and reflection S *k m*, E *k m* will receive, the former such an increment *k* S *i*, and the latter such a decrement *k* E *i*, as will restore their equality. Hence it appears, that if the distance of the eye remains unvaried, and also the elevation of the object H C S at the point C, the nearer the object S approaches this point, the nearer will the image approach to it; because, as the object accedes, the angle C S *i* enlarges, and consequently C E *i* must diminish.

But the various motions and positions of the image, caused by the obliquity of the mirror to the horizon, cannot be clearly understood but by investigating its path or place during a revolution of the mirror round the plumb-line. Let the line of direct vision E S be drawn, *b* C be produced to *d*, and from the intersection A of S E and B C produced, let A I be drawn parallel to it, and from *i* let *i a* be drawn also parallel until it meets the axis B C produced, in the point *a*; since *b* C is perpendicular to the mirror, so also will be I A, *i a* (El. 11, 7.); and if the mirror be supposed to revolve round the line B A, carrying with it, with its own angular motion the lines *b d*, I A, and *i a*, these will continue parallel and perpendicular as revolving together in the same plane with the line *b* C, which has no motion with respect to the mirror; but the line A I, as intersecting the line of sight E S, and perpendicular to the mirror, is always in the plane of reflection, therefore so also will the

will be equal to twice B C *b*; so that when this angle is nothing, the image will be at rest while the mirror revolves

the other lines parallel to it, and the image will always be seen in some part of the lines A I, *a i*; but these lines have a conical motion round the common axis B C *a*, and therefore the image will partake of that motion laterally as well as directly, during the revolution of the mirror from the plane (represented in the figure by the plane of the paper) in which the diameter *h* C is that most inclined to the axis of the motion A B; and the extent of the lateral motion will be limited within the angle C A I by the line A I, and not by any other line *a i*, because the former terminates both in the axis of motion and also in the line of direct vision E S, and has the same angular motion about this line, which the plane of reflection has during the revolution of the mirror; so that when the mirror or the diameter *h n* has made one-fourth of a revolution from its situation in the fixed plane E S H C, the image will have descended from the place *i* to the diameter *h n*, passing through the axis A B, and now at right angles to its former position; and will also have receded laterally from that axis to the distance C I, for it will always be seen in the diameter *h n* (which is most inclined to the axis, and wherein the line A I rests) during its revolution; and its distance, as measured on the surface of the mirror, from the plane E C H S, will be the sine of the angle made by the radius C I in its revolution; and its distance, the same way measured, from a plane passing through C, and at right angles to the former, will be the cosine of the same angle, and described by the radius C *i*: and from this it appears that the path which the image traverses on the surface of the mirror by the composition of such direct and lateral motions during a revolution is an ellipse, whose vertex is at *i*, its centre a point in the axis C A, its greatest semiaxis the perpendicular distance between *i* and A C, and its conjugate semiaxis the perpendicular distance between I and A C, and that the apparent path or *locus* of the image is the same ellipse seen obliquely by the eye at E, whose greatest semiaxis is equal to the sine of the angle C E *i*, C E being the cosine; and least semiaxis the sine of the angle C A I, made to subtend an angle whose cosine is also C E.

These ellipses will be formed in any part of the mirror, as well as the middle of it; because the same change of position of its surface during a revolution which is presented to the eye in whatever place it may view the image, will be the same: also the ellipses will enlarge with the inclination

volves round B C: if therefore the stem B C be so turned by the adjusting screws, that the point B will coincide with

inclination or obliquity of the mirror to the axis of motion, or stem of it, and their eccentricity will be inversely as the altitude of the object, if the distance of the eye and object from the mirror does not vary; for the angles C E *i* and C A I, determining the ellipse, enlarge with the angle B C *b* or H C *h*, but the lower the object is the nearer does the line of sight E S approach the mirror, and the conjugate semiaxis of the ellipse approaches to the vertex A of the angle C A I, within which it is confined; so that this axis, which is the sine of the angle C E I, diminishes with the altitude of the object, while the angle C E *i*, equal to twice B C *b*, remains unvaried.

If the relative distances of the object and the eye from the mirror be such, that the direct interval between the image *i* and the line E C is but little greater than I C, the visible place or path of the image will degenerate into a circle: if the image is at a less distance from E C than this, its place will be again an ellipse, whose transverse and conjugate axes will have changed place with those of the former one; but if the eye be at an infinite distance with respect to the object, the place of the image will be a right line at right angles to *h n*. Now from this enquiry result the following instructions:

1st. That such an injudicious situation of the eye and object might be pitched upon for the adjustment of the instrument, that the image would appear to move in a circle; in which case it would be impossible to determine in what part the mirror was most elevated; so that the object chosen for adjustment should be much more distant than the eye, and also not too much elevated above the level of the mirror; because then the elliptic path of the image will be more eccentric, and it will be easier perceived in what part of the mirror the vertex *i* of the ellipse is formed, which it has been shewn is the most elevated part of it.

2dly. That the person adjusting the mirror must make it revolve a full semicircle, in order that both vertices of the ellipse may be seen; for this, by doubling the greatest angle of aberration, may make it perceptible, though singly the motion and divarication of the images could not be observed: for which purpose the instrument must be changed on the needle, and replaced with its other side towards the arm K, which supports it: and if the case or vessel, in which it is suspended, could be

with *b*, (which is done by unscrewing the screw *s* 1, (Fig. 2,) and screwing up *s* 2,) then the plummet will bring back the stem C B from the place *b* to the line of gravity C B, and at the same time bring the diameter *h* C of the mirror to the horizontal position H N: and if the instrument be made with attention to the circumstances already mentioned, the change of its centre of gravity (if any) from the plumb-line, made by alteration of the stem, will be so little as to be quite imperceptible; but were that change ever so great, since the adjustment is made by what is afterward actually the plumb-line, it can produce no error, provided the weight which is appended remains the same.

By this means the level may be adjusted to a certain degree of accuracy, but never to any thing near precision; this can be effected by no means that I know so well as by the Hadley's quadrant itself, to whose use it is subservient, and from which in return it most readily receives its perfect adjustment; which is done by observing, when the image of a very remote object, as the sun or moon or a bright star in twilight, when near the meri-

turned partly round, it would facilitate the adjustment when done by the image of a very remote object.

3dly. That an observation may be made accurately by this level, even when it has a great error of adjustment; by taking the mean of the *greatest* and *least* altitudes of the observed object, which are discoverable by the greatest and least divarication of the images during a semirevolution of the mirror, which will be seen in that diameter of it, wherein is also the transverse diameter of the ellipse: and in it is to be taken one of the two altitudes, and, after turning the mirror half round, the other: the mean of these would reduce the reflected image to the centre of the ellipse, and is therefore the true angular distance or altitude. This advantage of the level did not occur to myself, but was suggested by Mr. Professor Brinkley, whose regard to the interests of science inclined him to give much attention to this instrument.

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dian and their altitude not great; or the top of a very distant mountain seen in the mirror coincident or in contact with the image of the same object reflected by the quadrant at the middle or edge of the transparent part of the horizon-glass, will preserve (in the same place of that glass) its coincidence unvaried, while the level is made to revolve half a turn round its axis: if the image in the level rises or falls from that in the quadrant, it must be adjusted by the screws as before. If the quadrant is furnished with a telescope that inverts, (by the help of which the adjustment may be rendered far more accurate than it could be done by the naked-eye) then the ascent of the image in the mirror, from the fixed image in the quadrant, must be regarded as its descent, and *vice versa*. Any *near* fixed object, of such length in an horizontal direction as to be seen, when no telescope is used, in the silvered and unsilvered parts of the horizon glass, will serve for the adjustment, provided the eye be fixed, by having the quadrant immoveably placed on a stand, or fastened to a board while the adjustment is performing; so that it may thus be very easily and accurately effected at any time even within doors, (care being taken that the floor of the room does not, by springing or bending, change the relative altitudes of the level and object from the ground, and their angular distance,) by fixing up as an object a strip of black paper or any kind of foil, &c. on a pane of the window, extended horizontally: and a small *fixed* telescope, furnished with cross wires set diagonally in the tube, (that the horizontal image may appear within the angles at the centre), and the wires placed at such a distance from the eye-glass, that a motion of the eye will not affect the apparent place of the image in the field of view, may be substituted instead of the quadrant, if it be more convenient

to

to do so; the manner of performing this adjustment is described underneath *.

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* Unless the adjustment by a *near* object be conducted in a judicious manner, a person may weary himself in doing it, where yet there is no difficulty. Let the quadrant be so fixed on a stand, or rather to an upright board, on which is fastened the arm K, supporting the level, that the two images may, by the motion of the index, &c. be brought to coincide near the middle of the mirror: the mirror may then be first turned round on the needle, until some certain diameter of it, as suppose that in the direction of the pillars *a a*, be in the plane of vision, or parallel to it, and the interval and position of the image in the mirror, with respect to that in the horizon-glass, should be remarked: the weight being then taken off, the mirror should be reversed, and its opposite side placed over the arm K; and when the weight is replaced, the same diameter of it should be brought into the plane of vision as before: the image in the mirror will now be seen in its highest or lowest position in this diameter as the place it appeared in before was the contrary; and the image in the quadrant should be raised or lowered, by moving the index, until this image is judged to be in the middle between those two places of the image in the mirror; and this latter should then be brought, by altering the two adjusting screws, which are for this purpose placed directly under the pillars, to coincide with the image in the horizon-glass. By a few trials, reversing the mirror, and altering the place of the images, until that in the quadrant is got into the middle between the extreme positions of the other image, (which is the centre of the elliptic path it describes,) and this latter image then made to coincide with the former, the aforesaid diameter of the mirror will be made level; and the diameter at right angles to it will be also rendered so, by turning the mirror about on each side, and altering the other two adjusting screws as the consequent elevation or depression of the image directs. If a telescope only, furnished with cross wires, be used for adjustment, instead of a quadrant, then the directions here given, with respect to the image in the horizon-glass in the quadrant, are to be applied, as if spoken of the centre of the cross wires of the telescope. A little practice will produce such a degree of dexterity in this operation, that the adjustment may be effected in a very short time; I have done it more than once (to the exactness of less than

a minute

It must be evident, from this account, that no error can happen in any observation made with this instrument, when it can be used at all in the absence of high winds, if its equilibration is permitted, by having the needle on which it is suspended as hard and finely pointed as the weight to be hung on it will allow, and the needle-cap properly made, with a fine apex and polished; for beside the error of adjustment, which may while it is using be detected, and either remedied, or the observation made truly, even when that error remains, (by taking the mean of the greatest and least altitudes the level affords in a semi-revolution of the mirror round its axis, as has been observed before,) it is liable to no other error but from a pendulous motion of the weight or a tremulous motion of the instrument itself from its being agitated by the wind; and if it is affected by either of these, it will be visible by the vibration or tremor of the image in the level compared with that in the quadrant which remains motionless. And I have found that it resists the action of the wind so well as to admit observations to be made in almost any weather in which a person would chuse to take them in the open air.

But I have observed its steadiness to depend on the following circumstances:

1st. That the whole instrument be as light as is consistent with the necessary strength, especially the parts remote from the point of its suspension, as the edges of

a minute of a degree) in less than ten minutes. The mirror will be more easily turned round its axis, without producing pendulous vibrations of the weight, and adjusted, if the weight be hung by a thread about a foot long, fastened to the looped string *t*, and made to swing thus in water contained not in its own case, but in another vessel, until the adjustment is finished: then the weight and level may be hung as before.

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ther this level will, when the arm K supporting it, is screwed to a tree, &c. be made steady enough by a weight, though it be not suspended in water; and since a stone or any thing almost will serve as an occasional weight, as also any vessel to hold water, in which case nothing is wanting to it that may not be every where supplied; and as the instrument, with the hook or arm K which supports it, might be made of a size not much

the musical and pendulous vibrations together, and might therefore adjust the length of the pendulum in every part of its vibration, so as to make its accelerating force as its distance from the point of rest.

As the extent of the disadvantages which would attend an enlargement of the size or weight of the instrument beyond what is necessary, may not be obvious, I must observe, that the accuracy of observations made by it chiefly depends on its steadiness in resisting the wind; and since the action of the wind is not momentary but continued, its effect will be probably proportional to the extent of surface exposed to it, and also to the quantity of matter it impels, and will be in a ratio compounded of both these, *i. e.* of the surface of the mirror and frame which is in the duplicate ratio of the diameters or dimensions of the several parts; and of the solid content of the instrument, which is in the triplicate ratio of the same diameters: so that if the diameter of each part be made twice greater in one of these instruments than in another, the action of the wind on the former will be exerted on four times a greater surface than is exposed to it by the latter, and on eight times a greater mass: it will therefore elevate the extremity of the stem, and with it the appended weight, in each tremulous vibration, four times higher in the larger than in the smaller instrument: and since the momentum of each is proportional to the versed sine of the arch of its vibration (which is the height to which the weight is raised), and also to its quantity of matter; and the magnitude and duration conjointly of the tremors are as the momentum: so the disadvantage of the instrument of double size will be to that of the other one in a ratio compounded of both, *i. e.* of 4×8, (or of 32) to 1, which will be reduced to the ratio of 16 to 1; because when the length of the stem is doubled, the power of the weight to suppress the tremors is doubled; from whence appears the necessity of making it as small and light as possible, because the appended weight cannot be conveniently enlarged.

greater

greater than in Fig. 2, so it may, when constructed in this form and size, be, as a concomitant to a small Hadley's sextant, an useful acquisition to a traveller who would equip himself expeditely: with this view, and for security against accidents, the mirror and the whole frame might be made of polished steel; and when it is constructed upon this smaller scale, the stem may with advantage be made a little longer than in proportion to the figure, because its length has relation not so much to the dimensions of the other parts, as to the length of the string, and quantity of the weight appended; both which may remain unaltered.

I would not have proposed the instrument here described, if I imagined that the level mentioned by Mr. Vince, (in his Practical Astronomy, page 33,) or any other one, were equally easy in its construction and use, and capable like this of being every where fabricated: that described by him is (as I understand it) a plano-concave lens, whose plane side is uppermost, and a reflecting level; covering a box filled with spirit of wine, except a bubble, which rests under the highest part of the concave surface; being a sort of spirit-level; but to procure it the accuracy of such, the radius of its concavity should be as great as that of a spirit-level; and I suppose it must be difficult to grind it truly to so great a radius *; and to find

* If any kind of spirit-level be made use of to fix a reflecting plane horizontal, and its bubble were, from the attraction of cohesion between the glass and the included liquor, to rest below the summit of the concave arch of the tube, &c. the error this will produce will be of an angle, double that measured by the arch of the tube between the point of rest of the bubble and the summit of the tube, (as can be collected from what has and will be mentioned); now I have intimated above, that not only the sensibility but the accuracy of the spirit-level, or its exemption from errors arising from this cause, will be improved by enlarging

find that point in the concave arch, at which a tangent plane would be parallel to the upper surface, and which point

larging the radius of curvature of its tube: and because it has been asserted, that "it could not be depended upon to greater accuracy than "one minute; for that when the radius of curvature of the level is very "great, the force with which the bubble rises to the highest point is "so very small, that the least adhesion of the liquor to the glass will "stop it, and its place of rest will be uncertain *," which seems to intimate, that enlarging the radius of curvature would be of little advantage: I hope I shall be pardoned for inserting the following statement, which inclines me to think otherwise; though an acquiescence in this as a fact would be a recommendation of the lever here described, which is not liable to such objection, and though it is only with diffidence and reluctance I can dissent from the very accurate and ingenious person who asserted this, and whose position I would not venture to controvert, had he stated his having ascertained the fact by experiment.

Let there be two such levels, whose curvature is represented by the arches A F, A G, fig. 7, A C being the radius of the former, and the point A the summit of both; and let the centre of the bubble rest, not at the point A but at D, making the angle A C D the error of the instrument, whose sine is B D, and versed sine B A: the same line B A will be the versed sine of the angle of aberration in all levels of similar construction and regular shape, whatever be the degree of curvature of their tubes; for because the force with which fluids move in any direction through a pipe or orifice is q. p. equal to the weight of the superincumbent fluid, which in this case is that of a column of liquor, whose altitude will be A B (if while the centre of the bubble is at D, its extremity extends to A; but less, and equally so in both tubes, if the extremity rests at a distance from A on either side); so the weight and height of this column must be in both levels the same, because it is counterpoised by the attraction of cohesion (I speak not of electric attraction) arresting the liquor, and preventing the extremities of the bubble from settling in an horizontal plane; which attraction is the ame and invariable in tubes of equal diameters whatever be their curvature, and therefore in both tubes A F, A G, the centre of the bubble will rest in the line B D: let it rest in the tube of lesser curvature or greater

* Vide Ludlam's Remarks on his Astronomical Observations.

point must be the centre of the bubble: also, were it properly constructed, it would require to be adjusted every time it is used or stirred from its place, unless it were set upon another level plane, and to make this adjustment would require the light of the day or a candle; so that it would not answer to make by night, and in any place, observations of the stars, which are often the only ones a traveller has an opportunity of making. I apprehend it would require at every observation a considerable part of the trouble of adjustment, which, in the level

greater radius at the point E, and in the other tube A D in D; then the arch A E, measuring the angle of aberration in the former tube will be to the arch A D the aberration in the latter in the inverse ratio of the line B E to the line B D; these lines are the sines of the angles; but the sine or ordinate of a circle is a mean proportional between the versed sine or abscisse and its complement to the diameter; for if lines be drawn from the extremes of the diameter to any point in the circumference, as for instance, to D in the circle A D, they constitute an angle in a semicircle, which must be a right one, (El. 3. 31), from whose vertex the sine B D falls perpendicular on the base; so that the versed sine A B is to the sine B D as this B D is to the complement of the diameter B H (El. 6. 8.); *i. e.* the rectangle A B, B H is equal to the square of B D (El. 6. 16.); also in the circle A E the rectangle under the same abscisse A B, and the complement to its diameter is equal to the square of B E: but these two rectangles, since one of their sides A B is common, must be in the ratio of the other sides; *i. e.* (because A B is so very small that it may be neglected), in the ratio of the whole diameters, or of the radii which are as the diameters; which ratio is that of the square of B D to the square of B E; consequently when the sines are as 1 to 2, the diameters or radii will be as 1 to 4: if the sines were as the radii, or as 1 to 4, the angles or arches A D, A E would be equal, but since B D is by supposition only half B E, and the angles are small, the arch of aberration A E will be little more than half the arch A D: and hence it appears that the error of the level will be q. p. in nearly the inverse subduplicate ratio of the radius of its curvature; so that when the radius is as 1, 4, 16, &c. the aberration will be as 4, 2, 1, &c. or as 1, $\frac{1}{2}$, $\frac{1}{4}$, &c.

 here

here described, serves once for all; for, after being adjusted, it requires no farther care than to keep the needle duly pointed.

As an instrument which does not, like this one, detect its own errors, may gain credit for an accuracy which it has not, it will be unfair to judge of the present level only from a comparison of it with such a one: the fairest trial of its adjustment, &c. will be made by observations taken in calm weather from the surface of a fluid of sufficient extent, and not covered by glass planes. If the weight were to be fastened to the stem without the intervention of a cord or hook, the tremors of the mirror would be suppressed, and the wind would communicate no motion to it, except a pendulous vibration affecting the whole mass. The Rev. Mr. Austin, for whose judgement in these things I had due respect, advised me to contrive the machine on this principle; and accordingly I made it in the following fashion, which, all circumstances considered, I found to afford the most commodious general use of it, and to render it sufficiently portable, as the whole may be contained in a round brass case nine inches in length, and less than three in diameter, supposing that of the mirror to be two inches and a half, nor need it be much heavier than the glass planes commonly used, together with the quicksilver, &c. required with them, even when made of a size as large as here proposed. It is represented, Fig. 8, in a vertical section through the middle, and one third of the intended size: though I think, if it were made of only twice the dimensions in the figure it might be sufficient.

M N is a cylindrical vessel or case, made of brass or wood, which contains the level: in the middle of the bottom of it (which should not be liable to bend) is firmly screwed a strong brass rod E E, tapering upward; and in the

the upper end of this is inserted the needle L, on whose point the mirror rests: the plate A is the mirror, B the brass plate cemented to it, in which is fixed the conical cap that receives the needle: this plate B is immoveably screwed and soldered to the end of the pipe C C, which pipe is seven inches and a half long, and widens downward, having a hole through its side, just under the projecting part at *g*, to prevent the condensation of air within it, when it is immersed in water, &c. to that depth: this pipe, towards its upper end, is so narrow as only to allow a small vibration of it on the point of suspension L, without bringing its sides into contact with the upright spindle E E, for thus it will present a less surface to the impulse of the wind; but when it vibrates on the needle, the lowest part only of the pipe must be allowed to strike against the rod E E, lest the point of the needle should be broken. The weight is represented at P P; it is a massive ring of brass, weighing about one pound and a half, soldered on the pipe C C, (or it might be cast in the same mass with it); after which the whole was carefully turned in a lathe, in order that its sides might be equally thick all around; for thus they will lie equidistant from the rod E E, when this is in a vertical position, and the instrument hangs freely on the point of suspension; *i. e.* when the case M N is set on its base, rests steady on the ground or some level stand, or is so supported, that it remains erect, and in circumstances fit for making an observation. To render it capable of being carried about in its case without injury, a brass ring, having the form and indenture in it represented at F E, is fastened within the case M N; which is done by four screws passed through its sides, that it, and also the level, may be introduced and taken out; and the upper part of the weight P P has a shoulder formed on it to fit and fill

the

the indenture *h* in the ring, into which it is unerringly introduced by the conical part of the weight above the shoulder, when the weight is pushed up to it; and this is done by advancing against it the screws D D, which move through the bottom plate of the case M N, and are furnished with locking nuts *ff* on the outside, to prevent their loosening: when the instrument is thus pushed upward in the case, the needle-cap at L is raised above the needle, and cannot injure its point; but may be let down upon it again by withdrawing the screws D, D. To steady the weight and mirror, any convenient liqnor, as water, vinous spirit, &c. is poured into the case through the open orifice O in its side, to the height of the ring F F, and may be let out again by another orifice (occasionally stopped) near the bottom; to prevent which, from running out at the screws D, D; plates of leather are interposed between the nuts *ff* and the bottom of the case: and if a ring of leather were likewise fastened on the shoulder *g* of the weight P P, or in the indenture *h* of the ring F F, and fresh linseed oil, essential oil, or any other, which would not rust the needle, were substituted instead of water, (if by experience oil should be found admissible), it would, by the pressure of the shoulder of the weight P P, when screwed up against the leather at *h*, be always kept in the bottom of the vessel from running out, and nothing would be wanting to fit the instrument at all times for observation but to take off the cover H H, to withdraw the screws D, D, (keeping the nuts *ff* in their places, and holding the case upright that the oil may remain at the bottom), and then to set down the instrument. But the same oil could not be long used; for unless every part of the metal which it could touch were coated with tin, it would grow foul and viscid by dissolving the brass, as it would also of itself in time;

and

and in cold weather and climates it would, by freezing or growing viscid, be rendered utterly unfit for this purpose: it has been disapproved of by a person of better judgement than mine; and is only proposed for experiment, should the instrument be used in visiting hot climates, where the needle would rust, and other liquors be scarce.

The want of adjustment of the level in this construction is discovered by the motion of the image reflected from it as before mentioned; and it is corrected by noting that diameter of the mirror, in which, during its revolution, the image appears most and least elevated; then supposing a vertical plane in that diameter to divide the whole instrument, marking a line across its base, *i.e.* across the bottom of the weight; if a due portion of the metal of the weight near that line be filed away on the side opposite to that in which the image is seen highest or lowest, the mirror will settle to the just horizontal position. For instance, suppose the most elevated place of the image seen in the mirror to be at the point *a* in the diameter *a b*; and that a perpendicular plane passing through the same, intersects the base or bottom of the weight in the line *c d*; if some of the metal be rasped away near *d*, on the side opposite to *a*, then the side *c* of the weight will be heavier than the side *d*, and will descend and approach nearer to the rod E E; and the side *a* of the mirror, which was too much elevated, will at the same time subside to a level position: and when this is once effected exactly, seeing that the instrument is one solid inflexible mass, whose centre of gravity cannot alter, it is plain that unless it should receive some injury, it will never after require any adjustment; but if it should, it may easily be rectified in the same manner.

To make the level more steady in the time of observation, a tripod-stand, like that of a telescope, might be fixed to the bottom of the case M N to support it; the feet of which might be contrived to turn upward, and rest against the sides of the case, when the instrument is not used. I could describe a mode of doing this, but can add no more to this paper, the length of which demands from me an earnest apology; observing only that as this level, if made on either of the two constructions here mentioned, may be adjusted to the utmost accuracy, so it also resists the agitation of the wind as well as the fluid level covered with glass planes, unless the quicksilver in the latter be likewise sheltered by a glass plate laid on its surface, which if the quicksilver should happen to be spilled would be useless; and supposing the plate to be of such uniform thickness and density, and to float so equidistant from the depressed margin of the quicksilver on every side, no air-bubbles likewise intervening, nor accidental contact with the sides of the vessel, that it would naturally lie parallel to the surface of the fluid, yet if this should accidentally be so overspread with dust or foulness, as to raise one edge of the plate, and depress the other, even so little as the thirty-three-thousandth part of an inch, it might give an altitude one minute of a degree erroneous *: and as these accidents are likely to happen

* If the radius of a circle be ten inches, each inch divided into a thousand equal parts, *i. e.* in the whole ten thousand, the sine of the arch of one minute is (not quite) three of those parts, or the $\frac{1}{3333}$ part of an inch: if the radius be only the $\frac{1}{5}$ of this, or two inches, the sine of one minute will be only the $\frac{1}{5}$ of $\frac{1}{3333}$ of an inch; *i. e.* the $\frac{1}{16665}$ part: consequently if the reflecting plate or mirror above mentioned were four inches in diameter, and it were accidentally tilted up at one edge, and depressed on the opposite one, even so little as the $\frac{1}{16665}$ part

happen to a person using that kind of level in travelling, so I am persuaded the instrument here described would remain longer serviceable to a traveller than any other for this purpose that I am acquainted with: and it is as being the most safely portable to any, and also manageable abroad at night when others are not so, that it is chiefly recommended; though after many comparative trials of the fluid-level with this one, I would, without consciousness of partiality, generally prefer the latter; for it is in fact a plummet, and may be made and adjusted to have the accuracy which in astronomical use, and like circumstances, the plummet affords.

part of an inch, it would be one minute of a degree oblique to the horizon: but I have shewn, that the greatest error of observation by a reflecting level, is always double the error of the speculum; hence half the above angle of obliquity of the speculum to the horizon, or an elevation and depression of its opposite edges from it, of the $\frac{1}{33330}$ part of an inch, (and how small a quantity this is, I leave to the conception of the reader) will, if the diameter of greatest obliquity happen to be in the plane of vision, produced an error in the observation amounting to one minute: the same is true of the level here described; so that the property of a screw in producing small motions is admirable, since its adjusting screws, even at the same distance (two inches) from the centre of motion, can in rectifying the speculum, be made to advance with precision enough, through a space far less than this, even so small as the one-hundred-thousandth part of an inch.

It is easy to conceive that the greater the size of this level is made *in length*, when it is constructed in the form of fig. 8, the more accurate will it be, and steady in resisting the agitation of the wind. Also that this fashion of it admits the more easy adjustment, as the mirror can be turned quite round on its axis, and the highest and lowest place of the image instantly discovered, consequently its error, if it has any.

Account

Account of a Method of preventing the premature Decay of Fruit Trees. By* JOHN ELLIS, *of New Jersey.*

From the TRANSACTIONS of the AMERICAN PHILOSOPHICAL SOCIETY.

THE decay of peach trees is owing to a worm, which originates from a large fly, that resembles the common wasp: this fly perforates the bark, and deposits an egg in the moist or sappy part of it. The most common place of perforation is at the surface of the earth, and, as soon as the worm is able to move, it descends into the earth, probably from an instinctive effort to avoid the winter's frost. This may be ascertained by observation, the tract of the worm from the seat of the egg being visible at its beginning, and gradually increasing, in correspondence with the increasing size of the worm; its course is always downwards. The progress of the young worm is extremely slow; and if the egg is deposited at any considerable distance above the surface of the earth, it is long before the worm reaches the ground. The worms are unable to bear the cold of winter unless covered by the earth, and all that are above ground after frost are killed.

By this history of the origin, progress, and nature of the insect, we can explain the effects of my method, which is as follows: in the spring, when the blossoms are out,

* This and the following paper having been transmitted by candidates for the premium which was offered by the American Philosophical Society, " for the best method of preventing the premature decay of Peach Trees," were considered as very deserving of public attention. It was therefore determined that the premium of sixty dollars should be divided between their respective authors.

out, clear away the dirt so as to expose the root of the tree, to the depth of three inches; surround the tree with straw, about three feet long, applied lengthwise, so that it may have a covering one inch thick, which extends to the bottom of the hole, the but-ends of the straw resting upon the ground at the bottom. Bind this straw round the tree with three bands, one near the top, one at the middle, and the third at the surface of the earth; then fill up the hole at the root with earth, and press it closely round the straw. When the white-frosts appear, the straw should be removed, and the tree should remain uncovered until the blossoms put out in the spring.

By this process the fly is prevented from depositing its egg within three feet of the root, and although it may place the egg above that distance, the worm travels so slow that it cannot reach the ground before frost, and therefore is killed before it is able to injure the tree.

The truth of the principle is proved by the following fact: I practised this method with a large number of peach trees, and they flourished remarkably, without any appearance of injury from the worm, for several years; I was then induced to discontinue the straw with about twenty of them. *All those which are without the straw have declined, while the others, which have had the straw, continue as vigorous as ever.*

Description

Description of a Method of cultivating Peach Trees, with a View to prevent their premature Decay; confirmed by the Experience of Forty-five Years, in Delaware State, and the Western Parts of Pennsylvania. By THOMAS COULTER, *Esquire, of Bedford County, Pennsylvania.*

From the TRANSACTIONS of the AMERICAN PHILOSOPHICAL TRANSACTIONS.

THE death of young peach trees is principally owing to planting, transplanting, and pruning *the same stock*, which occasions it to be open and tender, with a rough bark, in consequence of which insects lodge and breed in it, and birds search after them, whereby wounds are made, the gum exudes, and in a few years the tree is useless. To prevent this, transplant your trees as young as possible, if in the kernel it will be best, as there will then be no check of growth. Plant them sixteen feet apart. Plow and harrow between them, for two years, without regard to wounding them, but avoid tearing them up by the roots. In the month of March or April, in the third year after transplanting, cut them all off by the ground, plow and harrow among them as before, but with great care, to avoid wounding or tearing them. Suffer all the sprouts or scions to grow, even if they should amount to half a dozen or more, they become bearing trees almost instantaneously, on account of the strength of the root. Allow no animals but hogs to enter your orchard, for fear of their wounding the shoots, as a substance drains away through the least wound, which is essential to the health of the tree, and the good quality of the fruit.

If the old stock is cut away the third year after transplanting, no more shoots will come to maturity than the old stump can support and nourish, the remainder will die before they bear fruit, and may be cut away, taking care not to wound any other stock. The sprouts when loaded

loaded with fruit will bend, and rest on the ground in every direction for many years, all of them being rooted as if they had been planted, their stocks remaining tough, and their bark smooth, for twenty years and upwards. If any of the sprouts from the old stump should happen to split off and die, cut them away, they will be supplied from the ground by others, so that you may have trees from the same for 100 years, as I believe. I have now trees from one to thirty-six years old, all from the same stump. Young trees, formed in this manner, will bear fruit the second year; but this fruit will not ripen so early as the fruit on the older trees from the same stump. Three years after the trees are cut off, the shoots will be sufficiently large and bushy to shade the ground so as to prevent the growth of grass, that might injure the trees, therefore ploughing will be useless, and may be injurious by wounding them. It is also unnecessary to manure peach trees, as the fruit of manured trees is always smaller and inferior to that of trees which are not manured. By manuring you make the peach trees larger, and apparently more flourishing, but their fruit will be of a bad kind, looking as green as the leaves, even when ripe, and later than that of trees which have not been manured. Peach trees never require a rich soil, the poorer the soil the better the fruit: a middling soil produces the most bountiful crop. The highest ground is the best for peach trees, and the north side of hills is most desirable, as it retards vegetation, and prevents the destructive effects of late frosts, which occur in the month of April, in Pennsylvania. Convinced, by long experience, of the truth of these observations, the author wishes they may be published for public benefit, and has been informed, that Colonel Luther Martin and another gentleman, in the lower part of Maryland, have adopted a similar plan with great advantage.

Method

Method of managing Fish-Ponds, for improving the Size and Flavour of Carp, Tench, and Perch; by a Member of the Imperial Agricultural Society, St. Petersburgh; with additional Remarks and Improvements, adapted to this Country.

Communicated by Mr. RICHARD WESTON, *Leicester.*

THE quantity of fish to be supplied obviously depends upon the quantity of water, which should be divided, where it conveniently can, into five ponds: these may be distinguished by the first five figures, as 1, 2, 3, 4, 5.

No. 5 is intended for breeding, and should be double or treble the size of any of the other ponds. Or, if this be inconvenient, there may be two marked No. 5. This pond may likewise be the most distant from the house. If the breeding-pond should fail to answer this purpose, it will at least serve as a conservatory for fish of small size, to be obtained elsewhere; and indeed fresh stores in any case will be found desirable.

The contents of this pond in carp and tench, or the greatest part, should be taken out annually in September or October, counted in braces, and such as are from five to seven inches long put into No. 4.

The contents of No. 4, when grown one year, from the length of five or seven inches, must be put into No. 3. The contents of No. 3, having grown one year, from No. 4, must be removed into No. 2. And in like manner the contents of No. 2, after one year, must be removed into No. 1, which is to contain only such fish as are fit for the table. It is obvious that this pond, for safety and convenience, should be the nearest to the house.

As No. 5 is to be the largest water, so No. 1 is to be the least; the rest of sizes between the two.

The

The shape of No. 1 should be oblong, for the convenience of the net, and the less disturbance of the fish in taking out what are wanted from time to time.

A book should be kept to insert the number and size of each kind in every pond, and more particularly the number and weight of those taken out of No. 1, by which you will always know the stock fit for use.

If the nature of the ground will allow it, it would be proper that those ponds should be in sequence, one above another. By this method all the five ponds could be drawn with the loss only of some of the water from the uppermost, No. 1.

Carp are fit for the table from three to seven pounds each. Tench from one pound and a half to three pounds each. Perch from three quarters of a pound to one or two pounds.

It is supposed that none of the ponds have a current of very cold, acrid, or innutritious water.

One acre of water upon a loam, clay, or marle, with a mixture of gravel, has been stated to be capable of supporting 2000 pounds weight of fish, the number of the fish making that weight, being immaterial.

Carp and tench breed most freely in ponds or pits newly made. Tench likewise in almost any ponds where cattle are admitted. This is a hint that the mud should not remain in a pond too long without being taken out. A great quantity may readily be drawn out from the sides, by having a pole twelve or fifteen feet long, with a piece of iron fixed to it, eighteen inches wide and six broad, in the same manner as mud is drawn to the sides of a road.

If a pond be five feet deep, and mud is suffered to accumulate to the depth of one foot, the fish are deprived of one-fifth part of the water.

It is evident that perch and pike should not by any means be admitted into No. 5, but in all the other numbers, besides their intrinsic value, they are of important service, provided that they are strictly confined to a size greatly subordinate to that of the carp or tench. For they destroy not only the accidental fish which breed, but also several animals, whose food is the same with that of carp and tench, as frogs, newts, &c.

Pike, above the weight of one or two pounds, must not be admitted even amongst carp of the largest size and weight; and as they are of so voracious a nature, it is more prudent to admit of perch only.

The actual weight of fish, which any particular pond is capable of supporting, can only be determined by observation and experience, as it depends on the different degrees of nutriment in different waters.

It is said that carp and tench, in waters which feed well, will, before they are aged, double their weight in one year.

The third part of an acre in No. 1 would probably be sufficient for the demand of any family of four persons, besides servants. For, upon the calculation above given, it would support nearly 700 pounds of fish, which might be divided thus.

50 Brace of carp, of three pounds each and upwards.
50 Brace of tench, of two pounds each and upwards.
50 Brace of perch, of one pound each and upwards.

150 Brace.

That is three brace of fish, weighing at least upwards of twelve pounds, for the use of every week; and allowing a few ounces over in each brace will make up the weight 700 pounds.

Allowing

Allowing one acre for No. 5, one-third of an acre for No. 1, and one acre and two-thirds for the intervening numbers, the whole water would be three acres.

Upon this calculation the stock of No. 1, at one shilling a pound, would be worth 35 *l. per annum.* So that the value of each acre would be nearly twelve pounds annually; and there is scarcely any place in England but where such fish would sell for more, especially tench.

No. 1 being supposed to be near the house, and at no great distance from the garden; if the fish should not thrive sufficiently, (which will be seen by the disproportioned size of the head, and the whiteness or paleness of the scales,) they may easily be supplied with more food by loose pease from the garden; the sweepings of the granary, worms saved by the gardener in digging, and gathered from the walks; and the offal of the poultry killed for the kitchen; or by letting down the water about two feet, in the spring or summer, where there is a sufficient supply, and sowing the sides with oats, barley, rye, or wheat, very lightly raked in, and then stopping the sluice again.

Besides occasionally sowing the sides of the pond with a little corn, another method of supplying them with food should be practised, which is known but by few, and costs but little.

Float-fescue-grass is what fish are extremely fond of, both the leaves and seed, and is very nutritious. It grows very luxuriantly in shallow water, puts out roots at every joint, and is found growing naturally in many parts of England *.

* For more particulars relative to this grass see my account of it in the second number of the Monthly Register and Encyclopedian Magazine.

Plant some of this along the edge of the pond, and if cattle do not eat it, the seed will be ripe in July, and afford food for the fish.

In ponds already stocked, but not accurately regulated, it would be adviseable to begin with that which has the most pike, otherwise with No. 4, or what is intended for No. 4, and throw all the fish under five inches length into No. 5, and the larger, according to their sizes, into the other numbers; and so on with No. 3, 2, 1.

Store-fish procured elsewhere, if taken in summer, should be moved in the night, in clean straw wetted occasionally after they are packed; except perch and pike, which can only be carried in clean river, or pond water.

In removing fish from one pond to another, they should be first put into tubs of water already prepared for them, and afterwards carried in buckets without water. In taking pike or perch great care must be observed to avoid raising mud in the water.

In breeding-ponds all water-fowls, as geese, ducks, &c. should be discouraged, and herons in particular destroyed. If any white fish, as roach, dace, &c. should be found, they are to be taken; and if there be a spare piece of water for large pike, they should be put into it as food for the pike.

Eels may be put with advantage into any except the breeding-pond, in lieu of perch, or some of each sort. The most easy way of taking them is by trimmers, laid over night, baited with small fish, not with worms; otherwise they may catch the carp; or with a small thief-net baited with white fish.

Common sewers and drains from the laundry are prejudicial to fish; so are the leaves falling from trees in great quantities, which should be immediately raked out.

The

The use of grains should likewise be avoided in large quantities, as having little nourishment whilst they are thus washed by the water.

It seems better for the use of the table, as well as more humane, to kill fish designed for food by an incision with a sharp-pointed pen-knife, or puncture made with a pin longitudinally, into the brain, about half an inch, or an inch, according to the size of the fish, above the eyes. As this produces an instantaneous effect, it would probably save the cruel operation of crimping or slaying fish whilst alive, as in the case of pike and eels.

It is obvious, that this method of regulating fish, will apply with its full effect in larger spaces of water; it will likewise apply in a considerable degree to smaller pieces; even where the change is but from a pond for the use of cattle, to a single canal in a garden, which, if narrow and long, may be divided by boards with some holes bored for the water to make a current through them.

In situations near the great inland manufactures, and near the turnpike roads leading from an easy distance to the metropolis, water may be made, by this kind of management, with little trouble or expense, to produce a large annual rent.

To those who are very curious in the flavour of their fish, another improvement is recommended, of castrating the male carp: the method of performing the operation may be seen by referring to the Gentleman's Magazine, about forty years ago, which may readily be found by referring to the General Index.

As a regular system of managing fish-ponds is pursued but by few, those who choose to try the methods here recommended will find them attended with pleasure and profit.

New

New Method of making Cements for Terraces, and on the Employment of Liquid Pitch, to render them impermeable to Water, and capable of resisting Frost.

By CASIMIR PUYMAURIN.

From the BIBLIOTHEQUE PHYSICO-ECONOMIQUE.

I SHALL not speak of the nature of the various cements hitherto known; they have been described by many writers; I shall only say that a cement ought to be hard, solid, and impermeable.

To obtain a hard and solid cement, it was necessary to employ the different substances which, by their combination with lime dissolved in water, quickly absorb the superabundant water, and furnish the particles of lime dispersed through the cement with the carbonic acid requisite for rendering it solid.

Petrified lava, natural and artificial pozzolana, scoria of furnaces, pounded bricks, and the earth of bones, have been used as bases for all cements, and these materials have produced them more or less solid; cements thus composed have answered extremely well in the southern parts of Europe; being but little exposed to rain, they absorbed no external humidity and the frost could not, therefore, dilate their pores and destroy their combination.

The cements of Italy, Africa, and Spain, possess all the qualities that can be desired: but in rainy climates and countries exposed to severe frosts, impermeability is a quality more essential for cements than hardness and solidity.

Cements composed of porous substances cannot possess that quality; they are extremely hard and solid in summer, but the autumnal rains gradually communicate to them an insensible humidity; a sharp frost penetrates into their

their internal parts, and reduces to powder a mass which, a short time before, exhibited the appearance of the utmost durability.

The inventors of the most celebrated cements have seen their experiments fail from having neglected this essential quality: the interposition of a fatty material had already been employed. Pliny and Vitruvius recommended the dregs of oil, and oil itself; but these bodies, employed alone, cannot produce the effect intended. The oil with the lime of the cement forms a saponaceous matter dissoluble in water; the dregs of oil contain a great quantity of mucilage which water dissolves and carries off.

To preserve ships' bottoms and render them inpermeable to water, resinous substances are employed, and especially liquid pitch. I thought that by covering my cement with boiling liquid pitch, that this resinous body would penetrate the pores of the cement and render it impermeable to water.

There appeared one inconvenience in the use of pitch, namely, its being liable to become soft during the heats of summer. This quality I corrected by throwing upon the pitch pulverized lime; this lime combines with the pitch, and forms upon the cement an external coating of new cement, resembling the celebrated Roman cement called *malta*.

All the merit of my labour is reduced to this one point, that I am the first who, in order to preserve cements and render them impermeable, employed a greasy substance, capable of penetrating them, of stopping up their pores, and indissoluble in water.

I shall now proceed to the method I employ for making my cement, observing that the composition of cements cannot be regulated by one single method; differences must arise from the diversity existing between the quality

of

of the lime-stone, and sand, of one place and those of another; it is therefore necessary to examine the nature of the composition of the lime employed, and particularly the greater or less degree of purity of the sand and siliceous materials; and the proportions of the substances, that are to compose the cement, may be varied accordingly.

All the methods of making cements require in general that the pozzolana, pounded bricks, scoria, &c. be reduced to a fine powder and sifted. This precaution is essential in cements, if they are not to be covered with a resinous body; their surface is closer and more compact, and they are less liable to be penetrated by humidity. But this advantage is counter-balanced by the crevicesand cavities caused by the shrinking of the cement; this shrinking is prevented in my method of making cement, because I employ only hard materials coarsely broken into pieces of the size of grains of corn, and frequently as large as peas; these pieces thus broken form a great number of cavities and angles, to which the calcareous part penetrates, and composes an uninterrupted kind of chain which prevents the shrinking and cracking so prejudicial to cements. The lime which I have employed is made with hard, white, calcareous stone, from the coast of Cazeres, in the department of Upper Garonne: this lime dissolves with a bubbling, and a very great heat, and after it is dissolved it has the appearance of a white paste, without any mixture of gravelly particles; it is capable of *swallowing*, as the masons' here express it, a great quantity of sand and other hard materials; but it is less solid in the air than common lime, which being made with marly stone contains in its composition a great quantity of argillaceous particles burned and vitrified, which render its solidity extreme, when employed either in air or water. This lime requires the mixture of but a small

small quantity of sand, because the calcined and vitrified particles it contains form with it a perfect mixture; thus this lime, dissolved in water and no more thought of, acquires, in a short time, the durability of stone.

I had, therefore, ready for use, a lime perfectly pure without any internal mixture of heterogeneous particles, but likewise very difficult to be employed in a solid manner in the open air.

I discovered that a fifth part of lime was sufficient to give the cement the necessary adhesion for enveloping all the vitrified and siliceous particles with a calcareous covering, and consequently forming a coating of the greatest solidity.

The following is my method of proceeding, to form upon a flooring constructed 200 years ago, and the joists of which are very wide asunder, a terrace of 40 square toises which has resisted four severe winters, and as many scorching summers.

A necessary precaution, and the neglect of which caused me considerable trouble, is to pound the limestone before it is used; for although it dissolves in water when in lumps, it sometimes happens that, certain stones being less calcined than others, their central part is not dissolved, but only moistened by the water. This, when used, is mixed with the gravel and siliceous materials employed for the cement; in a few days the cement cracks, and the piece of lime is found undissolved.

Take two measures of well-washed river pebbles, or fragments of brick, of the size of a walnut, two of tiles and dross of iron, broken into coarse pieces, one of river sand perfectly washed, and a measure of fresh-pounded lime of Cazeres.

Then form a circle with the sand, into which circle throw the lime and slake it, having previously broken it to

to pieces with a hammer; when the lime is sufficiently diluted, it is left in that state for three hours, that the whole of it may be quite dissolved; then mix with it gradually the river pebbles, the iron-dross, the tiles, and the sand; beat up the mortar for about half an hour, that not a single siliceous stone, or fragment of tile, not perfectly incorporated, may remain *.

Such is the manner in which I prepare the cement: there are two methods of employing it either above or below the brick pavement; both have answered very well; the former appears the most solid the first year, whilst the other suffers the rain water to filter through; but in a certain time it acquires the most perfect solidity.

As the lime destroys the wood on which mortar is laid, if a terrace is intended to be made on a flooring, the brickwork must be laid in a mortar of earth and sand; when dry, another floor of brick is laid with a mortar composed of lime and sand; it is not necessary that the bricks should be cut but their surface should be rough or cut with the chisel; a sufficient declivity should be given to this pavement for the water to drain off.

In the month of July, when the two pavements are perfectly dry, the cement is made, and care must be taken to work and cut it with the edge of the trowel.

The cement is then collected with the trowel, the back of which is wetted a little; the surface of the cement is again compressed in order to cover the coarser particles, and to make it smooth; when one square is finished, proceed to the second, paying attention to join the two sides well that they may not separate.

* When the cement is almost completed, throw upon it pulverized quick-lime, in quantity about a bushel; the mortar then becomes very difficult to beat up, when a quart or two of whiting must be added, which penetrates and cements all its particles.

The

The cement soon dries, and in an hour's time is capable of bearing a considerable pressure. In seven or eight hours the surface of the cement must be slightly wetted, pressed down with smooth flint stones, and rubbed as if you were polishing marble; this last precaution is essential, and the solidity of the cement depends upon the care with which the operation is performed; the cement being thus composed, its adhesion increases, and its pores are less numerous and more contracted.

In order that the cement may succeed perfectly well in the method described above, it must be applied in portions of two feet square; two workmen are sufficient; the thickness of this coating of cement must be from two inches and a half to three inches; the surface of the bricks upon which it is laid should be wetted with whiting, and the cement pressed with force against the pavement with the trowel. This must be done during the month of July, that there may be time for the exhalation of the superabundant water in the composition, and that it may be perfectly dry before the rains of autumn.

At the end of August boil a quantity of pitch, of the same kind that is used for ships, and spread it in a liquid state over the cement, with rags fastened to the end of long sticks.

This covering, from its viscous quality, would render the terrace unserviceable during the summer, if the following process were not employed to correct it.

Take unslaked lime, reduced to a fine powder, throw it upon the pitch and with a birch broom sweep off all that does not adhere to the pitch; this lime combines with the pitch, and forms with it a very thin coating of a cement resembling the *malta* of the Romans.

At the beginning of October a fresh coating of pitch and lime is applied.

 The

The second method of employing the cement is to lay it immediately upon the first pavement of brick, and to cover it with the second pavement bedded in a mortar of lime and sand.

I have two terraces fifteen toises in length and one and a half wide, and they appear to me to possess the utmost solidity; they have not the beauty of those where the cement covers the brick-work, but they are capable of bearing any pressure or friction whatever.

After having laid the first pavement in a mortar of earth and sand, a layer of cement four inches thick is spread upon it. This cement must have been well worked, and pebbles added to it, rather larger than those employed in the process above described, and the quantity of lime must be proportionably increased. The cement should be then beat down with stampers such as paviors use, and left to dry for a month, when the surface should be wetted with whiting, and the bricks laid with good mortar made of lime and sand.

These bricks must not be broken or cut: I have remarked that by taking off the external surface of bricks which is semi-vitrified, you deprive them of all their solidity; there is then left only an earthy surface, which is soon penetrated by moisture, and easily destroyed by frost.

Care must be taken to fill up the interstices with good mortar, which must be pressed down, and polished with the trowel, and carefully covered with pitch.

Terraces made in this manner suffer water to filter through in small quantity for some time; this water, charged with calcareous particles, stops the pores of the cement; the filtration ceases, and these terraces possess the greatest solidity, and their construction is less expensive.

This

This cement may be employed with advantage in the interior of apartments, it may be substituted for brick floors, and costs but two thirds of the price.

It is spread upon a flooring of bricks made rough, or cut with any instrument to the depth of an inch or nine lines; instead of pebbles, it is composed of tiles and iron-dross broken into coarse pieces; it is pressed down and polished with smooth stones, but before it is painted it must be left to dry for a month. It may then be painted, and treated exactly like brick work.

Such are the details relative to the composition of the cement which I have employed, and which has perfectly succeeded with me. But, I repeat it, the quantities which I have mentioned must be varied in proportion to the greater or less purity of the lime, and the other materials employed; and the use of pitch is indispensable to prevent the filtration of the water, and the destruction of the cement by frost.

On the Extraction of Spirits from Potatoes. By M. Bertrand, *Apothecary of the Hospital of Instruction at Metz.*

From the Bibliotheque Physico-Economique.

In the year 3 (1795), when the utility of potatoes became a subject of general discussion, and when that utility was so ably demonstrated by M. Parmentier, scarcely any notice was taken of the spirit that may be obtained from that root.

Indeed, as the potatoe after boiling appears to have no saccharine flavour, it could not afford room for observations of that nature; it has not the sweet taste of beet-root, or carrots; it was not therefore likely to be presumed

sumed that it could yield a sufficient quantity of spirit to defray the expenses necessary for extracting it.

M. Poullmair, starch-maker of Metz, nevertheless succeeded in this point; but in ci-devant French Lorraine, at Sarre-libre, this operation is practised on an extensive scale.

The raw potatoe is hard, acrid, and disagreeable to the taste; it contains a kind of acrimonious principle, of which boiling does not deprive it. If boiled in small quantities in steam, it acquires a sweet mixed with an acrid flavour. If eaten without seasoning, the palate is soon palled, and salt must be used for correcting this taste.

The action of heat, by developing a slight tendency to saccharine fermentation in the potatoe, does not dispose it to yield a spirit in considerable quantity. The action of caloric disengages a great quantity of water, renders the root farinaceous, its skin is more or less cracked, and even peeled off when the potatoe is very flowery. Its substance appears like an aggregation of small detached particles, without any regular form, amongst which are discovered small shining bodies, which can only belong to the starchy fecula, of which they are the appropriate characteristic. It is easily reduced between the fingers into a friable substance, the particles of which appear to resist slight pressure on account of the mucilage and humidity which keeps them combined.

It is necessary to add a saccharine substance, a ferment of some kind, to facilitate the fermentation of the mucilage and starch which compose the principal part of the potatoe. Sugar, melasses, and honey would prove important resources, but only barley and beer-wort are employed.

The process is as follows.—Take 600 lbs. of potatoes, which in common years are sold for 1 fr. 50 c. but in the

year

year 11 (1803) are worth 3 fr. or 3 fr. 50 c.. The total cost of the 600 lbs. is therefore 21 fr.

They are boiled by steam, which takes three quarters of an hour; when boiled the potatoes should fall to pieces on being touched.

The vessel for boiling them consists of a tube, somewhat inclined. In the lower part of it are two holes; one about two inches from the bottom, through which passes the copper conductor for the steam, produced by a pot upon a coal-fire. The second aperture, provided with a peg, is for the purpose of drawing off the condensed water. A foot and a half from the ground, is hung on the outside an osier cylinder, into which the potatoes for the supply of the tub are put: in the upper part is an aperture large enough to admit the hand, and which can be hermetically closed: this is necessary for observing how the boiling proceeds.

After the potatoes are boiled, they are crushed and diluted with hot water till they are of a liquid consistence; to them are added 25 lbs. of ground malt (price 1 fr. 25 c.) and two quarts of wort (price 80 c.). The mixture is then stirred, and it is put into a tub till it is three quarters full. The tub is covered with a linen or woollen cloth, and is left at a temperature of 15 degrees.

After the fermentation and the exhalation of carbonic acid, the matter sinks down, and is fit for distillation.

By means of two stills this mass may be distilled and rectified in one day. The first spirit is of 13 degrees; the rectification raises it to 18. Two hundred pounds weight of coal are required, the price of which is 2 fr. One man may attend the two stills without preventing him from following other occupations. (The man's wages 2 fr.) Thus the total expense of 44 quarts of spirit amounts to 27 fr. 5 c. They sell for 36 fr. therefore the net profit is 9 fr.

The

The residuum may always be applied to a useful purpose, namely, the feeding of pigs. It is an excellent food to promote their growth, but should be changed in order to fatten them. I have remarked, that when a pig eats a great quantity of this residue, of which he is very fond, he is full, lies down, and remains a long time stupified. They are fattened upon potatoes, not fermented, but boiled, and diluted with the greasy liquor of starch-makers. This kind of food fattens them in a short time; but their flesh is not firm; and the fat of these pigs has not the appearance of that of pigs fed upon bran.

The spirit of potatoes has always, like spirits distilled from grains, an empyreumatic flavour; it appears to me to be owing only to the pyro-mucilaginous acid produced by the combustion and decomposition of the extracto-mucilaginous matter of potatoes. This empyreumatic taste may be corrected by rectifying the spirit with the kernels of fruit; but these are sometimes difficult to be procured. Could not this taste, which I conceive must be attributed solely to the pyro-mucilaginous acid, be neutralized by substances which have more tendency to unite with this acid, than it has with the spirit dissolved in caloric? I think that carbonate of lime might form a fixed pyro-mucite, whilst the spirit would be disengaged, more pure than before. Charcoal likewise appears to contain carbonate of potash capable of neutralizing this acid.

If, as some authors imagine, this taste proceed from an oil, alumine might then be of considerable assistance; but unfortunately this substance being commonly very impure, does not always answer.

Transactions of Societies for promoting useful Knowledge.

LONDON.

Royal Society.

ON the 25th of November, a paper was read, containing an account of the experiments of Professor Aldini, on Galvanism.

The author divides his subject into three parts; in the first he professes to examine the nature and properties of Galvanism. In the second he treats of its power of restoring the vital functions. And in the third he considers its medical application.

In reasoning concerning the nature and properties of Galvanism, M. Aldini brings forward several experiments, with the view of proving what had been often before asserted by different philosophers, and particularly by Galvani and Humboldt, namely, that the metals are not essential in producing muscular contractions in the limbs of animals; and that Galvanic combinations are capable of being formed merely by animal substances.

In treating of the power of Galvanism in restoring the vital functions, M. Aldini details several facts of the action of the pile of Volta upon warm-blooded animals, and upon the human subject. In one experiment, in which the communication between the ends of the pile was made by means of the biceps muscle, and the spinal marrow, an hour and a quarter after death, contractions of the arm were produced sufficiently strong to elevate it six inches above the table.

With regard to the medical application of Galvanism, M. Aldini professes great hopes of success, particularly in cases of drowning or strangling: and he states that in these cases the effects may be produced without dissec-

tion, by making a connexion by means of water, holding in solution salt, between the end of the pile and one of the ears, and a hand, in the subject operated upon. He states, that he has already tried Galvanism in disorders of the brain, with great success; and, by means of it, he asserts, that he has cured two persons of melancholy madness.

In concluding his memoir, M. Aldini mentions, that he has several times observed a very sensible attraction between the nerves and muscles of animals in cases when, after having been separated from the body, and possessing a certain degree of vitality, they are brought very near each other.

An account of a journey to the summit of Whararai, a mountain in the island of Owhyhee, by Mr. Archibald Menzies, naturalist on board the Discovery, Captain Vancouver, was read on the 9th and 16th of December.

In January, 1799, the Discovery being stationed in Karakakooa bay, Mr. Menzies was desirous of making a botanical excursion into the island of Owhyhee, in company with some other gentlemen of the expedition, and in particular of ascending a conical mountain in the neighbourhood, called Wharar ai. For this purpose he was furnished with a numerous company of attendants by the king of the island, under the command of one of the chiefs, who was made responsible for his safety, and for his perfect accommodation with provisions of all kinds, and who executed his task with as much fidelity as the whole troop performed their labours with alacrity. Mr. Menzies had a portable barometer, of a simple construction, by which he ascertained the height of different places as accurately as the time would allow. The island appeared to be in general in a state of high cultivation:

5 the

the provisions for the journey consisted of live hogs, poultry, dried fish, yams, and cocoa-nuts, in quantities that loaded more than twenty men. They left the sea-side the 17 of January; after coming by water to the foot of the mountain, the barometer standing at 30.10, the thermometer at 81°, at noon. The road was through lava and other volcanic productions for about three miles: here the plantations of bread-fruit trees began, and the country was fertile and pleasant; the night was passed in the uppermost village, consisting of a few scattered huts. Beyond this was a thick forest, skirted by fruitful plantations of bananas and plantains; about three miles within the forest, the elevation appeared to be 2,600 feet above the sea. The thermometer was 59°, at noon. The natives constructed a number of small huts, which afforded shelter to the whole party for the night, at the upper extremity of the forest. Here the thermometer was at 58°, in the evening: the uniformity of temperature at heights considerably different, Mr. Menzies attributes to the shelter of the forest, and the evaporation from the trees. But the next morning the thermometer was at 43°. The summit of the mountain was ruggid and barren; Mr. Menzies arrived at it in a few hours from the last station. It afforded a very extensive view of the island, although parts of it were hidden by clouds: its most conspicuous features were two other mountains, of which the summits are covered with perpetual snow, bearing E. N. E. and S. E. by E. of Whararai. On this hill there is a very deep crater of a volcano, with ashes and cinders appearing quite fresh: the natives consider it as the habitation of evil spirits, whom they attempt to pacify by offerings of various kinds. The party of travellers spent the whole of this and the following day on the mountain, and passed the night in caverns, thatched with plantain leaves, and

strewed with grass and mats for the occasion. The sophora tetraptera was in flower, as a small shrub; in the lower parts of the island it becomes a tree, of which the natives make their spears, and which takes a fine polish. The dodonæa viscosa thrived on the summit of the hill; and a small shrubby geranium was found there. The height appeared to be 8000 feet above the sea. The thermometer was lower at sun-set than at seven in the morning.

Mr. Menzies descended on the south-east side of the hill, and arrived in the afternoon at a deep cavern, where he past the night. Hence he made a fruitless attempt to ascend the snow-clad mountain, on the other side of the valley, in which the natives accompanied him with the greatest reluctance; the same cavern received him the following night. The centre of the island between the three mountains is barren and uninhabited; it appears to be elevated about 5000 feet above the sea. Returning towards the shore, the party arrived the next evening at a village nine or ten miles from Karakakooa Bay, surrounded by fields and plantations, in the highest possible state of cultivation; its elevation appeared to be about 2000 feet. Here they were entertained by an exhibition of much grace and great activity, in the performance of a female dancer belonging to a strolling party. The next day was the last of the excursion; and the natives were dismissed with rewards of knives, files, scissars, looking-glasses, and tape, of which a small portion was surrendered by each to the king. The barometer now stood at 30.12, and the thermometer at 74°.

Royal Institution of Great Britain.

In conformity to a regulation unanimously adopted by the managers of the Royal Institution, held at the house of

of the Institution, on 17th January 1803, the lectures for the ensuing season, by Dr. Young and Mr. Davy, commenced on 26th January.

They will be delivered on Mondays, Wednesday, Thursdays, and Saturdays, at two o'clock P. M. and on Tuesdays and Fridays at eight o'clock in the evening, Good Friday excepted; and be continued until the completion in the ensuing season, of at least one hundred lectures.

The first volume of the Transactions of the Institution is now completed. In the last number the editors have inserted a catalogue of books, composing the library of the Institution, amounting to 421 different works, a list of other presents, and of the names of donors to this establishment.

Highland Society of Scotland.

The anniversary meeting of this Society was lately held at Edinburgh. The reports of the committee for promoting the improvements of the Highlands by roads and bridges, and the projected canal across the island from Inverness to Fort William, were laid before the Society; together with the communications which the directors lately had with Mr. Telford, the engineer employed by government to survey and report upon the practicability and plan of carrying these improvements into effect. Since passing the act for the commutation of the servitude of thirlage, and which had originally been brought forward by the society for encouraging the improvement of waste lands and agriculture, it had become the general opinion of the country, that an extension and amendment of that act, in some particulars, would be very beneficial; it was therefore resolved to make application to the legislature, for such extension or alteration of the thirlage act, as they should see proper

and

and expedient for rendering that law of more general utility.

The Secretary reported, that the second volume of the Society's Transactions was now in the press, and would be published in the course of the season: that it would contain a great deal of useful information, on a variety of subjects connected with the views of the institution; and several papers on the fisheries and other subjects, for which premiums had been adjudged last year.

There was also read a letter from Benjamin Bell, Esq. accompanying one hundred parcels of Egyptian barley, made up in half-ounces, with a similar number of the Swedish turnip-seed, called *roota baga*; both these kinds of seed are stated to possess a variety of qualities, superior to any seeds of that kind formerly known in this country, and which had been tried by Mr. Bell himself, with great success. The meeting ordered that these parcels should be sent to the directors, with instructions to distribute them among such members of the society as were considered the best farmers, and likely to be the most attentive to their cultivation; and to report to the society the result of their experiments.

Intelligence relating to Arts, Manufactures, &c.

Wheel Carriages.

M. Tarin, of Paris, has obtained a *brevet d'invention* (patent) for an invention to be attached to carriages of every description, to prevent them from breaking down. The advantages proposed by this invention are, 1st, that it preserves in equilibrio, without the slightest shock, and stops in its course, however rapid, any carriage to which it is adapted, either if the axle-tree suddenly break, or if the nuts of the wheels should come off. 2d. That it enables

enables any carriage to continue its route to the place of its destination, even with a broken axle, or if the nuts be lost 3d. That it produces no additional weight, and is so far from being apparent, that you must know that it is attached to a carriage before it can be discovered.

Water-proof Cloth.

A manufactory of cloth impermeable to water has lately been established at Paris; vessels are made of it capable of containing liquids, extremely light, and not liable to accident. It is likewise used for covering sheds for horse-cloths, water-spouts, bags, and even for great-coats. It has the peculiar merit of being supple and elastic; it is an admirable substitute for skins and leather, is not affected either by dryness or humidity, and loses none of its qualities in boiling water at its utmost degree of heat. It has already furnished many of the public as well as private establishments of Paris with buckets to be used in case of fire.

Polishing Steel.

M. Guyton has announced to the National Institute a method of preparation of crocus martis, or colcothar, which he considers new; and at the same time communicated some observations, which may be of considerable use to those artisans who employ a great quantity of this material. He says that in manufactories where it is used in a large way, a substitute may be found in some species of red woods, of the nature of the Almagra, which is employed in Spain for this purpose. He farther states, that this material may be obtained without labour or much expense, by steeping old hats, or black felts of any kind, in diluted sulphuric acid. The dye is soon reduced to the state of red oxyd, and the residuum need only be washed to get rid of the acid which adheres to it. The colcothar thus produced is of the utmost degree of minuteness.

List

List of Patents for Inventions, &c.

(Continued from Page 160.)

WILLIAM BEER, of Ely-place, in the city of London, Medical Professor, and Dealer in Medicine; for a medicine, and method of administering the same, for the more effectually and expeditiously curing the gout, rheumatism, &c. Dated December 9, 1802.

JOHN BARNETT, of Birmingham, Warwickshire, Toy-maker, and JOSEPH BARNETT, of the borough of Warwick, in the said county, Cutler; for a new and improved method of making parasols and umbrellas. Dated December 21, 1802.

MATTHEW WYATT, of Queen Ann-street East, Middlesex, Esquire; for a fire-grate upon an improved construction. Dated December 21, 1802.

THOMAS SAINT, of the city of Bristol, Engineer; for a method of increasing the effect of steam-engines, and saving fuel in the working thereof. Dated December 21, 1802.

JOHN LEWELL, of Gresse-street, Rathbone-place, Middlesex, Stove-maker; for a register-stove upon improved principles. Dated December 21, 1802.

JOHN SCOTT and JAMES CLARKSON, of Lower-street, Islington, Middlesex, Brick-makers, WILLIAM TATHAM, of Staples-Inn-buildings, Holborn, Esquire, and SAMUEL MELLISH, of Holborn-court, Grays-Inn, Gentleman; for new-invented articles, which they have denominated "Tatham's Clumps," for the purpose of constructing water-pipes, sewers, tunnels, wells, conduits, reservoirs, or other circular walls, shells, or buildings. Dated December 21, 1802.

MICHAEL BILLINGSLEY, of Birkinshaw, Yorkshire, Engineer; for an instrument, engine, or machine, to be worked by steam, water, or horses, for the purpose of boring cylinders, &c. Dated December 22, 1802.

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Pl. XI. Vol. 2, second series

Fig 8

Fig. 2.

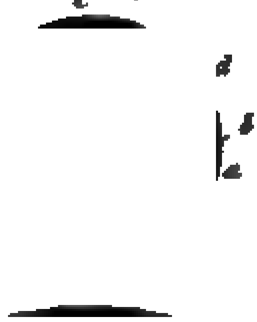

Fig. 4.

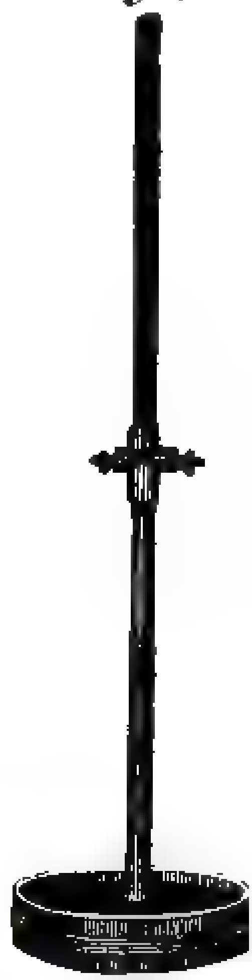

Fig.

Fig. 3.

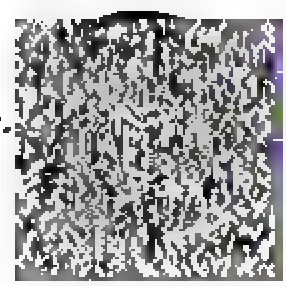

Fig. 9.

Fig. 11.

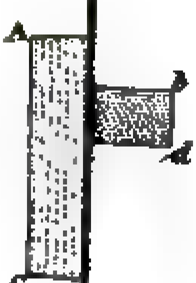

Fig. 16.

Fig. 14.

Fig. 15.

THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

NUMBER X. SECOND SERIES. MARCH 1, 1803.

Specification of the Patent granted to HENRY GARDINER, *of the City of Norwich, Corn-Merchant; for a Method of preventing all Sorts of Corn and Seeds, and various other Merchandize, from receiving Damage by Heat on board Ships and in Warehouses; and of improving all such Corn, Seeds, and other Merchandize, as may have received Damage by Heat or otherwise, and rendering the Corn and Seeds so damaged much sweeter, and more fit for the Sustenance of Man and other Animals, and for the Purpose of Vegetation.* Dated April 15, 1802.

With a Plate.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said Henry Gardiner do hereby declare, that my said invention is described in the annexed drawing, and the following descriptions thereof; that is to say: First,

for preserving corn on board ships, in any part of a ship most convenient, fix an air-pump, which is to be made as follows.

Fig. 1, (Plate XI.) A, represents a cylinder, made of lead, with a projecting rim at top and bottom, under which are collars of iron.

Fig. 2, B, an iron plate, to be screwed to the projecting rim at the top of the cylinder, and having a collar of woollen cloth to make it air-tight. *a*, a hole in the centre of the plate, through which the piston-rod passes. *b*, a circular box, on the top of the plate, in which are collars of leather, screwed down by a brass nut, so as to make the piston-rod air-tight as it moves up and down. *c*, a valve of leather, covered with woollen cloth, fixed on the inside of the plate, and opening downwards, to admit air into the cylinder on the descent of the piston. *d*, a small spring, on the outside of the plate, to assist the return of the valve when the piston rises. *e*, a valve, fixed on the outside of the plate, and opening upwards.

Fig. 3, C, an iron plate, to be screwed to the projecting rim at the bottom of the cylinder, having a woollen collar as at Fig. 2. *f*, a valve on the inside of the plate, the same as *c*, Fig. 2, but opening upwards, to admit air into the cylinder on the ascent of the piston. *g*, a valve on the outside of the plate, but opening downwards, having a small spring for the same purpose as *d*, Fig. 2.

Fig. 4, D, a piston. *h*, an iron plate, to which two cup leathers are screwed, and made to exactly fit the inside of the cylinder, and into which one end of the piston-rod *k* is fixed. *k* and *n*, a piston-rod in two parts. *m*, a brass cross, having an iron bolt through it horizontally, and into which one end of the piston-rods *k* and *n* are screwed.

Fig.

Fig. 5, E, a receiver, made of lead, having a circular end or pipe G, the end *r* of which is to be screwed to the iron plate, Fig. 3, over the valve *g*.

Fig. 6, F, a circular pipe, also of lead, similar to G; one end of which is to be screwed to the iron plate, Fig. 2, over the valve *e*, the other end being screwed to the end *o* of the receiver.

Fig. 7 is a front view of the air-pump or machine for forcing air into ships, fixed in a wood frame.

Fig. 8 is a side view of the same machine.

References to Figs. 7 and 8, *viz.* *a*, a wheel; *b*, a pinion, or small wheel; *c*, the crank, by which the machine is worked, and which is made to fix on and take off at pleasure; *d d*, a double crank, on one end of which the wheel *a* is fixed; *e*, *e*, two levers, loaded with lead, as counterbalances to the crank; *f*, a clasp-rod, one end of which receives the double crank, and the other ends are fixed to the brass cross *m*, Fig. 4; *g*, a bar of iron, having a hole with a collar of leather in the centre, through which the piston-rod passes, and by which it is kept perpendicular; *h*, *h*, two iron stays, fastened to the frames, and screwed to the top of the cylinder, to keep it steady; *k*, *k*, &c. four iron stays to fasten the cylinder to the bottom of the frame, two in front and two behind, not visible in the plate. The capital letters A B C D E F G have the same reference in all the figures of the plate.

There must be a ventilating-bottom, formed of hollow perforated frames, as about to be described, which should lay a little above the keelson, about eighteen inches from the bottom of the ship; and the width of the ship must be measured at that depth, and the dimensions of the ventilating-bottom determined thereby. The frames should be of a convenient size for two men to lay down

 and

and take up with ease. Small vessels will require two rows, and larger ones three rows of frames.

Fig. 9, represents the bottom of a hollow frame, made of wood, about three-fourths of an inch thick; the boards of which it is formed being placed lengthwise from A to C and B to D, by which method the boards will lay across the ship, and as the frames must be cut to fit the masts and sides of the ship, it will be best to prepare all the bottoms of the frames first, for the convenience of forming those which are to fit the masts and sides.

Fig. 10, represents the top of the frame, also of wood of the same thickness and dimensions, and placed and cut in the same manner and form as the bottom, Fig. 9; but having holes therein, about nine in every square inch, made with an auger or gimblet, about one-eighth of an inch diameter, but not nearer to the sides than about two inches, or the holes may be made large, at equal distances, but not so close as to weaken the frame too much, say about half an inch or an inch; or, generally, let the distances between the holes be about the diameter of the holes. But in this case the frames must be covered with coarse linen, or hair cloth, before the corn is shipped; next prepare a sufficient number of supporting pieces of wood, Fig. 11, about two inches square, and of sufficient length. These are to be fastened by nails or screws to the bottom, Fig. 9, about fourteen to eighteen inches from each other, as from S to V, *n* to *m*, *o* to *n*, *e* to *a*; and thus, being placed in a contrary direction, *viz.* across the boards, which form the frame, they will support them very securely. Let the ends of the supporting pieces of one frame meet the ends of the supporting pieces of the adjoining frame, which may easily be done by measuring the distance carefully, and in particular

ticular let this be attended to in the middle of the bottom, so as to form a main channel or passage for the air, from one end of the ship to the other; from which it will diffuse itself on all sides under the whole bottom of the cargo. Prepare also a sufficient number of pieces of sound dry wood, about two inches square, which I shall call supporting points. These are to be fastened by nails or screws entered at the bottom of the frame, and which nails or screws, passing through the supporting pieces, are to enter the square pieces or supporting points, thereby fastening them to the supporting pieces at about fourteen inches distance from each other, see Fig. 11, to form supporting points for the top of the frame, the supporting pieces being fastened to the bottom of the frame, and the supporting points to the supporting pieces, as above directed. The top of the frame is to be laid upon the supporting points, each corner to its corresponding letter and corner of the bottom, and is to be fastened by nails or screws passing through the perforated top, and entering the supporting points. All the ends of the frames which are to lay next the ends, and sides, and masts of the ship, are to be whole; and those side pieces are next to be fastened on so that the air can rise only through the perforations in the top of the frames. A sufficient number of frames being prepared, they should be numbered, for the convenience of laying them down in regular order. If the edges of the top of the frames be made angular, so as to fit into each other, it will form a very secure and simple fastening, which may be farther secured by hooks and staples, if the frames, in consequence of the wood drying, should not unite close enough to prevent the corn falling into them. There must be a hole, in a convenient part of the middle row of frames, in which one end of the air-

pipe

pipe or trunk is to be fixed, in a sloping position, towards the place where the air-pump is suspended or fixed, so that the other end may enter the case of the air-pump, and the spout of the receiver E (Fig. 5.) inserted into it. If this air-pipe is made of tin, or lead, it will be easy to give it any direction required. The air-pump, being inclosed with boards on all sides and at the bottom, is to be fixed or suspended in any convenient part of the hold near the top; having only so much of its upper part above deck, as is necessary for turning the crank. The case should be large enough to admit a person to go into it to fix the spout of the receiver to the air-pipe, and secure it so that no air can escape. The case of the upper part above deck, must have a door on one side, for an entrance into the lower case, and which door should be open when the machine is worked to furnish a supply of air. Previous to shipping the cargo, make every part of the inside of the ship, where the corn is to be put, air-tight, which may soon be done with a little pitch. If the cargo is to be shipped in bulk, without any partitions, the bottom of the hold is to be filled with corn to the intended height, just above the keelson, when the ventilating bottom is to be laid down, and the air-pipe or tube fixed therein, communicating with the receiver of the air-pipe, as before directed, and the remainder of the cargo shipped; which being done, turn the crank *c* of the air-pump, and the contents of the cylinder will be forced into the air-pipe, and thence under the bottom of the cargo. At every stroke of the piston in a cargo of wheat, one thousand quarters, containing eight thousand Winchester bushels, the interstices are about one seventh, or one thousand one hundred and forty-three bushels; consequently, in working an air-pump whose cylinder contains only two Winchester bushels of air, fifty strokes in

in a minute, which may be done with great ease for four hours, the one thousand one hundred and forty-three bushels of confined air will be expelled, and twenty-four thousand bushels of fresh air will be forced through the cargo. The longer the air-pump is worked at a time, the more complete will be the effect; because the resistance occasioned by the weight and compactness of the corn compels the air to diffuse itself under the whole cargo with a sufficient equal degree of compression in all parts, and is therefore soon compelled to rise through the corn.

Having described my method of ventilating whole cargoes, I now proceed to describe my method of ventilating any part of a cargo, or one part more than another. It is common in coasting-vessels to have parting-boards, (which is therefore unnecessary to describe), for the convenience of separating different persons' corn, and also different qualities and sorts of grain: such vessels, also, carry different sorts of grain in the same room; such cargoes are to be thus shipped. Prepare a sufficient number of perforated frames; but with this variation, that there must be a set of frames for each room, or partition, having those sides whole which are to lay next the partition-boards, and the ends or sides of the ship, thus forming a separate ventilating-bottom for each room or partition. Each room must have a lead, or tin-tube, or series of tubes, or air-pipes, one end of which is to be inserted into the bottom, and the other end rising to the top of the hold, and thence into the case of the air-pump. The lower partition-boards should rise only so much above the keelson as the ventilating bottom is intended to lay from the bottom of the hold; which being made air-tight, the room is to be filled with corn, level with the top of the lower partition-boards. The perforated frames are then to be laid down,

and

and the air-pipe fixed in its place. The upper partition-boards are next to be fixed up, and the remainder of the corn intended for that room put on-board ; the other rooms are to be filled in the same manner till the cargo is completed. If two different qualities or sorts of grain are to be shipped in one room, they must be separated by coarse cloth or mats, not however to be laid double. Sail-cloth, which is commonly used, will not do, as its close texture obstructs the air. I have before observed, that there must be a lead or tin tube, or series of tubes, leading from the perforated bottom of each room to the top, and from thence to the case of the air-pump ; the latter parts of them are to be affixed as the rooms are completed, and are to run horizontally on the top of the cargo, immediately under the deck, in such a manner that one end of a short tube may easily be adapted to the spout of the receiver, and the other end to the tube, or series of tubes, communicating with the room it is intended to ventilate. These tubes should fit into each other very exactly. If care be taken to work the air-pump regularly when the corn is first shipped, it will be the most effectual means to prevent damage, as any disposition to heat will be thereby speedily counteracted by the cool fresh air arising through the corn. Care must be taken to let out as well as to force in the air ; for which purpose a few small apertures, in convenient places, near the hatchways, will be proper. Any single room may thus be most effectually ventilated ; and, by ventilating each room successively, I am very sure it is quite practicable to carry a cargo of corn round the world in good condition.

To preserve corn in granaries, the air-pump herein described, or the ventilating machines invented by Dr. Hales, may be used ; a description of which may be found in most cyclopedias ; and to which it is not meant

by

by me to make any pretensions, but rather to recommend the same, except for ships, for which they are very cumbersome and inconvenient; the priviledge claimed by this patent extending only to the construction of the floors, and to the use of the air-pump herein described; in all cases the granary to be fitted up with a ventilating floor, and must be made air-tight.

The following is a description of a granary fitted up with a ventilating floor.

Fig. 12, A B C D, represents the granary. E, the entrance. S S, a space, of sufficient width, for the purpose of carrying corn to and from the partitions. G, G, G, G, a line of boards, to support the corn in the partitions. *a* to *e* lines of boards having posts therein as at *o*, &c. to form partitions for different qualities or sorts of grain; the lower boards should be made to fit the floor of the granary so as to be air-tight, which may be done by stuffing the bottom carefully with tow, to prevent any air escaping to the adjoining partitions. *a a a*, where posts are to be fixed, have groves on the side toward *e*, to receive the ends of the line of boards *a* to *e*. *e e e e e*, where posts are to be fixed, having grooves on the side towards *a*, to receive the other ends of the line of boards *a* to *e*, &c. and also on the sides, in a line with the line of boards G, G, G, G, into which the ends of the boards which form the ends of the partitions, or the line G G G G, are to be inserted. *o o o*, &c. where posts are to be fixed, having grooves on the sides towards *a* and *e*, to receive the ends of the boards, which form the partitions; 1, 2, 3, 4, four partitions, to receive as many different qualities or sorts of grain. H H, an air trunk, to convey air to any or all the partitions P and V, where the air-pump, or ventilators, may be placed. If worked by hand, there must be a communicating pipe, or series of pipes, lead-

ing from the receiver of the air-pump, or ventilator, to the partition intended to be ventilated. If the ventilators are placed in the attics, or above the floor to be ventilated, there must be pipes leading from them, and uniting with the communicating pipe above mentioned, as at K, or K. Prepare a sufficient number of perforated squares, of convenient size for two men to lay down or take up with ease.

Fig. 13, *a b c d*, represents a perforated square, made of wood, about three-fourths of an inch thick. The boards of which it is formed are to be placed lengthwise, from *a* to *b*. The ends and sides of the squares, which are to join the ends and sides of other squares, are to be formed in an angular manner, so as to fit each other; which will prevent their rising up by any unequal pressure upon them, and form no obstruction to the shovels in working the corn. Make the holes exactly as described for Fig. 10.

The form of the granary to be fitted up with a ventilating floor is not material, care being taken to form the squares so as to fit the posts and inequalities, whether projections or recesses, of the ends and sides; and that the ends of the squares on the side G G G G, extend even with the outside of the posts in the line G G G G. Prepare also a sufficient number of supporting pieces of wood, Fig. 14, about two inches square, and of sufficient length to be fastened across the boards of the perforated squares, as from *a* to *c*, *b* to D, &c. about 14 to 18 inches from each other, care being taken that the ends of the supporting pieces of one square meet the ends of the supporting pieces of the adjoining square, so as to form regular channels for the air, as described for ships. Prepare also a sufficient number of pieces of sound dry wood for supporting points, about 2 inches square, Fig. 15, which are to be fastened, about 11 or 12 inches distance

distance, to the supporting pieces, see Fig. 16, for the perforated squares to rest upon, so as to elevate them sufficiently above the floor of the granary. Ventilating floors may also be supported simply by fastening pieces of wood for supporting points, at about 12 or 14 inches from each other, to the bottom of the perforated squares. The situation of the partition posts in the line G G G G must be determined by the size of the partitions; which being fixed upon, they are to be placed at the ends of the partitions, as at *e, e, e, e, e*. And if the partitions are so large as to require it, there may be supporting posts in the line G G G G, made to fix and take down at pleasure, at convenient places, to support the weight of the corn on the line G G G G.

The method of fixing the lower partition boards in the line G G G G must be determined by the manner in which it is proposed to convey air under the floor. If it is intended to ventilate the partitions separately, the lower partition boards are to be fixed exactly as described for the lines *a* to *e*, having a hole about the middle of the end of each partition, into which one end of the communicating tube, or air pipe, is to be inserted during the ventilation; and in this case it will save trouble, if all the lower partition boards are fixed permanently, so as to be air-tight; and they need not be much higher than the perforated floor. If an air-trunk, H H, is used, there must not be any lower partition boards, as above described, in the line G G G G; but the lower partition boards in that line are to rest edgewise, upon the end of the perforated floor. And, not having any holes in them, the partition boards should be numbered, for the convenience of fixing them up in regular order; and should be of convenient size to fix up and take down with ease. The lower partition boards being fixed up, and made air-tight, the per-

 forated

forated squares are to be laid down, stuffing tow in such places as may be necessary, if they should not be perfectly close in all parts; which done, the floor is ready for the reception of corn for ventilating; observing to cover it, as mentioned for Fig. 10, if the holes are large.

If it is intended to work the ventilators by a wind-mill, fixed upon the top of the granary, the most convenient place to fix them in is the upper floor, or a convenience made in the attics, immediately under the roof, where they will be no incumbrance. If it is intended to work them by hand, an air-pump, or small ventilator, may be placed at either end of the space S S, as at P or V, of a commodious size to remove them to any other floor, if required. If it is intended to work them by horses or steam, they may be fixed under the lower floor, in a place formed for the purpose, or in an adjoining building. In all mills worked by wind, water, or steam, it is easy to work any number of ventilators desired; and, whichever way is chosen, small bells may be adapted in such a manner as to tell when the ventilation is suspended.

In large granaries it will be necessary to have several pairs of large double ventilators fixed so as to work one or more at a time, with pipes leading to the respective floors which they are intended to ventilate. Wherever the ventilators are fixed, there must be a pipe, or series of pipes, leading from the receiver to the floor of the granary to be ventilated, and there united to another pipe, or series of pipes, to convey the air under the partition to be ventilated. If the granary is fitted up without partitions, the air may be forced under the ventilating floor, at either of the sides, at the ends of the supporting pieces.

Another

Another method may be adopted to convey air under the corn when partitions are used; *viz.* by an air-trunk, H H, to be placed outside the posts, in the line G G G G, the whole length of the granary. The trunk H H is to be square, about 6 inches diameter, and closed at both ends, made of stout boards, with holes on the side next the partitions, about 2 inches diameter, in the middle of each space between the ends of the supporting pieces or channels formed under the floor by the supporting points, and having plugs to fit the holes very exactly. Immediately opposite to the above-mentioned holes on the side of the air-trunk, towards the space S S, are to be other holes, sufficiently large to put a hand in, for the purpose of fixing the plugs in the holes towards the partitions, and having also plugs to fit them exactly. The heads of the small plugs should not project much within the air-trunk; and the small end of the large plugs should not enter far into it. Thus, leaving as little obstruction to the air as possible, the air may be forced into the air-trunk, H H, at either end; or at both ends, if several ventilators are worked at a time. The air-trunk, H H, must go perfectly close to the ends of the partitions and posts, in the line G G G G, so as to be air-tight; the ends of the perforated floor resting on the air-trunk, as before observed, which may be fastened to its place by a few iron hooks, or otherwise; there must also be a pipe, or series of pipes, communicating from the receiver of the ventilators to the air-trunk, similar to what have already been described. If it is intended to ventilate all the partitions at once, take out all the plugs on the side next the partitions, and fix in all the plugs on the side S S, and work the ventilators, previously spreading the corn as equal in depth as possible, in all parts of the granary; but where there are partitions

titions it will generally be best to ventilate them separately. For which purpose, let the corn be laid an equal depth in all parts; then close all the holes towards the partitions, except of that to be ventilated, and all the holes on the side S S, and work the ventilators. The plugs may always be made to fit exactly by being bound with a little tow, if necessary.

Ventilating floors may also be formed of wire, perforated iron, tin, or bricks supported upon another floor, as described in this specification.

Stale and fusty corn, being spread thin and ventilated, as herein described, will be rendered much sweeter, and more fit for the sustenance of man, and the purposes of vegetation; and all cold and damp corn or seeds, which have been harvested in bad condition, may be much improved, and its natural colour preserved, by drying it upon a perforated wood floor, such as described in this specification, covered with tin, soldered so securely as to be air-tight in all parts, by means of steam or heated air, conveyed under the same; but it is not here meant to claim any exclusive right to any particular method of conveying steam or heated air under such perforated covered floor, but only to the construction of the floor itself. And I do hereby declare, that any person making or using a perforated wood floor, such as is described in this specification, and covering the same with tin, for the purpose of drying corn, seeds, or other merchandize, thereon, by means of steam or heated air conveyed under the same; any person doing so without my consent is deemed to encroach upon my patent. Having described my method of ventilating corn on board ships, and in granaries, and improving stale, fusty, and damp corn, seeds, and other merchandize, in the most exact manner I could, and so I think as is easy to be understood and practised

practised by any person, I now proceed farther to describe the rights granted by this patent as follows; that is to say: any person making or using a perforated wood floor in any of the ways or forms described in this specification, so as to be applicable to the purpose of ventilation, or forming or adapting any wire, perforated wood, iron, tin, or brick, floor, to, with, or upon, any other floor or materials, for the purpose of ventilation, or any other purposes herein mentioned, by supporting the same as herein described, or conveying air for the purpose of ventilation by an air-trunk and communicating pipes, formed and placed as herein described; any person doing so without my permission is deemed to encroach upon my patent. Also, any person making or using a ventilating bottom for ships, formed of hollow frames, as herein described, or shall make or use a ventilating machine or air-pump similar to the one described in this specification, is deemed to encroach upon my patent. But it is not here meant to claim an exclusive right to the use of wood, wire, iron, tin, or other floors, in the manner in which the same have been used before; but to a new method of constructing them, and of affixing, adapting, uniting, or connecting, them, to or with any other floor or materials, for the purpose of ventilation, and other purposes herein mentioned, in any of the ways or forms described in this specification. In witness whereof, &c.

Specification

Specification of the Patent granted to JOSEPH DE OLIVEIRA BARRETO, *late of Lisbon, but now of Old Burlington-street, in the County of Middlesex, Esquire, and* MARY DE LIMA BARRETO, *his Wife; for a Method of treating and curing of Ruptures.*

Dated August 30, 1802.

TO all to whom these presents shall come, &c. NOW KNOW YE, that I the said Joseph de Oliveira Barreto, in compliance with the said proviso, do hereby describe the nature of our said discovery, and the method of the treating and curing of ruptures to be as follows; that is to say: That our said invention and discovery doth consist of an ointment or salve, composed of the several drugs, and mixed and compounded in the proportion following; namely, one pound of incense, pulverized, one pound of almecago, one pound of turpentine, one pound of balsam of capivi, and one pound and a quarter of white or virgin wax, and in the same proportion for a greater or less quantity, always adding one-fourth more of white or virgin wax. I likewise farther declare, that the best method of making this ointment is by first pounding the incense and almecago till it is reduced to a fine powder; then mix it with the turnpentine and capivi, repeatedly stirring it, for the space of three days, in a strong basin or bowl of earthen-ware; then melt the wax to an oily substance, and when so melted all the other ingredients are then to be thrown in, when the whole is to be put on the fire, and stirred for a quarter of an hour. Then leave it for eight days; and after the expiration of those eight days it must be put on the fire again, and be well stirred for a quarter of an hour, and when cold it will be fit for use.

And,

And, lastly, I declare that the best method of using and applying the same, and the rules and regimen to be observed and attended to by the patients, are as follows. Cut a piece of leather the size of the rupture, or rather larger, and spread the ointment over it; then warm it a little, and apply it exactly upon the rupture. The patient, however, must first lie on his back, and if the intestines are down they must be returned; and when they are restored to their proper place and position, then the plaster must be immediately applied to the part, and then secured or fastened, by means of a truss, as tight as possible, and remain so for fifteen days; after which time the plaster is taken off, and a fresh one put on, for the space of fifteen days more, making altogether thirty days. But it must be perfectly understood, that after the application, namely, on the first day, the patient must go to bed, and remain there for twenty-four hours; and during the whole thirty days he must be extremely cautious not to ride on horse-back, nor walk fast, or any distance; that he should avoid going up and down stairs as much as possible, and should not lift any weight, or use any exertion, so as to extend the muscles: that he must also be very particular in his diet during the thirty days, and avoid eating butter, oil, and all similar substances; and also be extremely moderate in drinking, as well as in every other respect during all the before-mentioned period limited for the cure of the complaint in question. In witness whereof, &c.

Specification of the Patent granted to WILLIAM NICHOLSON, *of Soho-square, in the County of Middlesex, Gentleman; for Machinery for the better and more expeditious manufacturing of Files.*

Dated August 14, 1802.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said William Nicholson do hereby declare that my said invention is described in manner following; that is to say: My machinery consists in four essential parts suitably constructed and combined together; namely, First, a carriage or apparatus, in or by which the file is fixed or held and moved along, for the purpose of receiving the successive strokes of a cutter or chizel. Secondly, the anvil by which the file is supported beneath the part which receives the stroke. Thirdly, the regulating gear by which the distance between stroke and stroke is determined and governed. And Fourthly the apparatus for giving the stroke or cut. The four several parts aforesaid are supported by, or attached to, a frame or platform of solid and secure workmanship, either of wood or metal, or both, according to the nature of the work intended to be performed, and the judgement and choice of the engineer.

The carriage is a long block of wood, or metal, of the figure of a parallelipidon, or nearly so, having a portion cut out between its upper and lower surfaces to admit the anvil to stand therein, without coming into contact with the carriage itself. The said carriage is made of such a length that the excavation here described shall be considerably longer than the longest files intended to be cut; and it is supported upon straight bearers from the plat-

form

form, upon which by projecting pieces, or slides, or wheels, or friction-rollers, it can be moved endwise in a straight lined direction, without shake or deviation. At one end of the said excavation is fixed a clip, resembling an hand-vice, for holding the file by its tail or tang; and in the opposite end of the said excavation there is a sliding block or piece, which being brought up to the other end of the files does, by means of a notch or other obvious contrivance, prevent it from being moved sidewise. The said clip is so fixed at its head or shank by means of an horizontal axis, on gudgeons and sockets, that the file is at liberty to move up and down, but not sidewise or atwist. In this manner it is that the file being fixed in the carriage is pressed down upon the anvil by a lever and weight proceeding from the platform, and bearing upon the face of the file by a small roller of wood, ivory, bone, or soft metal.

The anvil is solidly fixed on the platform, and may be of any suitable figure which shall be sufficiently massy to receive and resist the blow; but its upper part must be so contracted as to stand up in the excavation of the carriage, and support the file; and the upper part of all must be constructed in such a manner that it shall fairly apply itself to the under surface of the file, and support it without leaving any hollow space, notwithstanding any casual irregularities of the said surface. I produce this effect by making a cavity in the anvil, of the figure of a portion of a sphere, not much less than an hemisphere, and in this cavity I place (with grease between) a piece of iron, or steel, made exactly to fit; but of which the lower surface is a greater portion of the sphere, and the upper surface flat and plane. The file rests upon this last flat or plane surface, which is either faced with lead, or (in preference) a slip of lead is put under the file and

turned round the tang thereof, so as to move along with it. It is evident that the upper, or moveable piece of the said anvil will, by sliding in its socket, accommodate and apply itself constantly to the surface of the file, which is pressed and struck against it. Or, otherwise, I make the concavity in the upper moveable piece, and make the fixed part convex: or, otherwise, I support the upper part, or in some cases the whole of my anvil, upon opposite gudgeons, in the manner of the gimbals of sea-compasses: or, otherwise, I form the upper part of my anvil cylindrical, of a large diameter, supported on thick gudgeons, the axis of the said cylinder being short, and at right angles to the motion of the carriage: or, otherwise, I form only a small portion, namely, the upper extremity of my anvil of a cylindrical form, as aforesaid, and cause the same to continue motionless by fashioning the same out of the same mass as the rest of the anvil, or fixing the same thereto. And in both the last mentioned cases of the cylindrical structure I fix the head or shank of the clip, (by which the tang is held), not by a single axis or pair of gudgeons, but by an universal joint or ball and socket, so that the file becomes at liberty to adapt itself not only upwards and downwards, but also in the way of rotation or atwist, and supplies the want of motion in the anvil by the facility with which itself can be moved in the last mentioned manner.

The regulating-gear is that part of the machinery by which the carriage, and consequently the file, is drawn along. It consists of a screw revolving between centres fixed to the platform, and acting upon a nut attached to the carriage with the usual and well known precautions for working of measuring screws; and the nut being made to open by a joint when the carriage is required to be disengaged and slided back. And the said screw is moved

either

either constantly by a slow motion from the first mover; or (which is better) by interrupted equal motions, so as to draw the carriage during the interval between stroke and stroke. And the quantities of those respective equal motions may be produced and governed at pleasure by wheel-work applied to the head of the screw, or by the well known apparatus used in the mathematical dividing engine for circles; or by various other contrivances well known to workmen of competent skill, and therefore unnecessary to be described at large: or, otherwise, the motion of the carriage may be produced by a toothed rack from the carriage drawn by a pinion; and this pinion moved by a ratchet-wheel on the same arbor moved by a click-lever, which shall gather up and drive a greater or less number of teeth, according to the coarseness or fineness of the file; and the click-lever itself may be moved by a tripping piece from the first mover, or by various other evident means of connection: or, otherwise, the said carriage may be moved by a small cylinder, and rope or chain constantly acting: or, otherwise, the said motion may be effected by a train of two or more wheels, suffered to move by any of the escapements used in time-pieces, and the fineness of stroke may be regulated either by changing the wheels as in the common fuzee engine, or by the greater or less frequency of escape during each turn of the first mover. And in every case I prefer a counter-weight to the carriage, acting either constantly against, or constantly in the direction of its motion; though this is not absolutely necessary when the work is well executed. I may also observe, that it is possible to construct my said machinery by fixing and rendering motionless that part which I have called the carriage, provided the other three principal parts be made to move instead of the carriage itself; but I consider

sider this disposition as less eligible than that which requires the carriage to be moved.

The apparatus for giving the stroke, or cut, consists of a chizel, which is held between the jaws of a mouth-piece or claws, resembling a strong hand-vice without teeth. One of the jaws is made very stout, and the chizel is formed narrow from edge to back, and wide from side to side, and has a semi-circular protuberance on its back, which rests in a circular notch in the strong jaw aforesaid; and there are two or three bended flat rings or washers of iron or metal under the thumb-screw of the said mouth-piece, or claws, which prevent the chizel from becoming loose by the stroke. Or, otherwise, the said chizel may have a notch, or a hole, instead of a protuberance, to meet a correspondent part in the mouth-piece, or claws; but I prefer the first mentioned construction. By the constructions of the chizel, as here mentioned and fixed, the edge of the said instrument is at liberty to apply itself fairly from side to side of the file, notwithstanding any winding or irregularity, whatever may be the fineness of the cut upon a broad surface. The mouth-piece, with its chizel, is firmly fixed in another piece, which by its motion gives the stroke. This last mentioned piece may either be a lever, or a moveable carriage between upright sliders; but I greatly prefer the lever. The chizel must be so fixed that the moving piece shall carry it fairly edge-onwards to the file without scraping or slapping in the least; and the obliquity of the stroke may be adjusted by fixing the centres of the lever either higher or lower at pleasure, or by inclining the last mentioned sliders. The lever may be raised and let fall (or the other chizel apparatus moved) by a tripping piece or snail-work, or other usual connection with the first mover, and its power of stroke may be increased by the addition of

a weight,

a weight, or by the action of a spring; which last method is of excellent use, and may (if required from the varying breadth of the file) be made to increase or diminish its power during the run by several easy and commonly used methods or contrivances for pressing more or less against the spring. Or, otherwise, the lever, or holding-piece, may be kept immediately above the file by the re-action of a slight spring, or weight, and be struck by an hammer moved and acted upon by the first mover, as aforesaid: and to this method I give the preference, because the lever will then have less strain upon its pivots; or, the said lever may even be supported by spring-joints without any pivots or centres at all. Or, instead of a hammer, the blow may be given by a ram, or a fly and screw, but I give the preference to the hammer. The lever may move in a vertical circle immediately over the file, or in an oblique circle at right angles to it, or at any intermediate angle consistent with the foregoing instructions: and the chizel may be set with its edge at any angle whatever, with the line of the length of the lever; but, in general, I have set the lever in the first mentioned position, and have varied the angle between the chizel-edge and the lever, according to the intended slope of the cut upon the face of the file. The edge of the chizel must be sharpened to such an angle as the intended cut and strength of bur may require.

Lastly, I describe the general action of the said machinery as follows. 1. The file being prepared as usual for cutting, must be fixed in the clip of the carriage, and the sliding block brought up and fixed, to steady its other extremity. 2. The nut of the screw being then opened, (or the other regulating-gear disengaged), the carriage is slided to its place, so that the chizel may be situated

over

over that part of the file which is to receive the first stroke. 3. The nut is then closed, (or the other regulating-gear connected), and the small roller of the pressing lever is made to bear upon the face of the file. 4. The first mover being then put into action, raises and lets fall the apparatus for giving the stroke by which the file receives a cut. And 5. immediately afterwards, or during the same action, as the case may be, (according to the construction as before described), the regulating-gear moves the carriage, and consequently the file, through a determinate space. 6. The cut is then again given; and in this manner (the strength of cut being duly proportioned to the space between cut and cut), the file becomes cut throughout. 7. The file is then taken out and cut on the other side. 8. The bur is then taken off, or not, as the artist may think best: and the cross-strokes are given over the surfaces as before. And the said machinery by certain slight, necessary, and obvious changes in the structure and disposition of the chizels, and some other of the parts thereof, is adapted to manufacture all other forms and descriptions of files, whether floats, rasps, half-round, three-square, or of any other figure or denomination.

In witness whereof, &c.

Specification

Specification of the Patent granted to John Leach, *of Merton Abbey, in the County of Surrey, Callico-printer; for a Method of using Madder in the dying of Calicos, Linens, and Stuffs, wherein a considerable Saving is made in the Consumption of that Root or Drug.*

Dated April 6, 1802.

To all to whom these presents shall come, &c. Now know ye, that I the said John Leach, in obedience to the proviso or condition contained in the said letters patent, do, by this present deed or instrument, under my hand and seal, describe and ascertain the nature of my said invention, of a method for the use of madder in the dying of calicos, linens, and stuffs, whereby a considerable saving in the consumption of that root or drug is made, and the manner in which the same is to be performed; that is to say: That whereas the practice has hitherto been in the dying with madder to use river-water, pond-water, spring-water, rain-water, or other water, in its natural state, my invention is, that water, being first prepared by heat, either in an open or a steam-tight vessel, will thereby be rendered more efficacious for extracting the tint dye or colour from madder. that this improvement or melioration in the quality or virtue of water for the purpose of dying with madder; may be produced from a less than boiling-heat in an open vessel, and a greater than boiling-heat in a steam-tight vessel: but that the most sure and certain method to obtain that end in its fullest extent, is to continue the water at a boiling-heat for a certain space of time; and that the efficacy or improved quality in the water will increase in proportion to the time it is kept in a boiling-state; first shewing itself after a few minutes boiling, and

advancing progressively for thirty minutes or upwards. That water which has been boiled for the space or time of thirty minutes (little more or less), will be brought to a perfect state for the purpose before mentioned, and that if the boiling be continued for more than thirty minutes, the virtue or efficacy of the water will not be materially improved; and, after boiling thirty minutes, it will be proper to suffer it to cool and subside before it is used, though it will answer very well if used before cooling: and that water, being first prepared by heat as before laid down, may be repeatedly used in the dying with madder, provided the same be preserved from impurities, which may be done by keeping the liquor, after boiling or dying with madder, until the vegetable or earthy parts are subsided. In witness whereof, &c.

Account of a Method of obtaining the Salts of Iron at the Minimum of Oxidation.

From the Journals of the Royal Institution of Great Britain.

THE sulphate, muriate, and acetite of iron, at their minimum of oxidation, may be obtained in a very easy manner, by means of the artificial sulphuret of iron. When artificial sulphuret of iron is acted upon by muriatic acid, or sulphuric acid in a state of dilution, or acetous acid, the sulphureted hydrogene gas, disengaged during the process of solution, prevents any hyperoxygenated salt from being formed by the action of the atmosphere; and a clear fluid, in all cases, of a shade of green, is obtained, which, when freed by heat from any

any sulphureted hydrogene dissolved in it, gives a perfectly white precipitate with the alkaline prussiates, and is not found to alter the colour of solution of galls.

To form the least oxygenated nitrate of iron, by means of the artificial sulphuret, an acid of a specific gravity, not greater than 1.12, must be used, and the solution must be made without the assistance of heat. After having been freed from sulphureted hydrogene, by being boiled for a minute or two, and then filtrated, it is found similar in its colour and physical properties to the weakest solutions of the other oxygenated salts.

When the sulphate and muriate of iron, at the minimum of oxidation, are obtained in the solid form, by evaporation from their solutions, they appear in regular crystals, which in each salt are a different shade of a very pale green colour; their tastes are exactly similar, being astringent, and leaving in the mouth the sensation of sweetness.

The least oxygenated nitrate of iron cannot easily be procured pure in the crystallized state, for when the solution of it is heated for any length of time, a new arrangement of its principles takes place; portions of the acid and of the water of the solution are decomposed; in consequence of which ammoniac is formed; and an oxygenated nitrate of iron, with excess of base, is deposited.

Amongst the salts of iron, at the minimum of oxidation, I have found the muriate the most convenient, for exhibiting the experiments of Proust, and in eudiometrical processes with nitrous gas. It is more soluble in water than the sulphate, and very much more soluble in alcohol.

Practical Observations on the Methods hitherto practised for ventilating Hospitals, Gaols, &c. and Description of an Invention for correcting their admitted Imperfections.

By Sir George Onesiphorus Paul, *Bart.*

With a Plate.

From the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce.

The Thanks of the Society were voted to the Author for this Communication.

Desiring to be understood as not addressing the Society as a claimant of their premium; I conceive I may assist them in the pursuit of their laudable purpose, by submitting to their perusal some practical observations on the modes of ventilation hitherto practised, and by communicating the outline of a design already conceived, and in a limited degree adopted, for correcting their admitted imperfections.

It may be necessary to premise, that the peculiar enquiry, the result of which will be detailed in the following pages, was excited by some objections originating in a most respectable quarter, and directed against a system on which I had heretofore *solely* depended, in providing for the ventilation of such public establishments as have been placed more particularly under my direction.

It may be inferred from the note annexed to the proposed premium, that similar objections are entertained by the Society: I shall therefore submit my observations, without that delay which would necessarily be occasioned by my modelling them in conformity to the rules you have communicated, and waiting

Page 2A

ies.

ing for certificates to accompany them. If there really does not exist a doubt as to principle or fact, on a question so important, should not that doubt be made the subject of a previous special consideration, so that a point of direction may be given to the mechanical exertions intended to be excited?

Although particular conclusions may be controverted, I may venture to assume as the basis of all observations on this subject,

First, that a certain and frequently renewed supply of vital air is essential to the purposes of animal life; and the more regular and uninterrupted that supply, the more favourable will it be to health.

Secondly, that where the quantity of atmospheric air introduced into an apartment is less than nature has bestowed in free circulation, her purpose is in a degree counteracted; and although the breathing impure air (*i. e.* air despoiled of its natural proportion of vital air) for a short time may not produce an immediate sensible effect, an injury may arise to the constitution, proportionate to the extent of that time. And farther, when (as in the ordinary intercourses of society in London) persons are in the habit of placing themselves, during a considerable portion of every twenty-four hours, in a situation to breathe in this defective atmosphere, the accumulated consequences may be serious and important.

Thirdly, that in rooms from which currents of fresh air may not be excluded, they may be so injudiciously directed as to be useless and injurious. And,

Fourthly, that if, in addition to the consumption of vital air by the lungs, the persons of those assembled in any apartment should be filthy,—should their clothing (particularly that made of woollen) have been so long worn as to have absorbed any considerable portion of the perspiration

perspiration of the body,—or should the apartment itself be damp and foul, the vital properties of the air will be contaminated, and although instant death may not ensue (which has been known to be a consequence), the fevers emphatically termed the Gaol, Hospital, or Ship Fever, from its usually originating in these places, will be generated with a degree of malignancy proportionate to its causes, and, being so generated, will become infectious with a like degree of malignancy.

It is about twenty years since the deleterious consequences of inattention to ventilation were set forth by Mr. Howard. So strong and so general was the conviction of the public mind, not only as to the evil pointed out, but regarding the remedies proposed by that indefatigable philanthropist, that the legislature thought fit to adopt the whole of his principles, and to make them the basis of several positive laws, under the direction of which the greater number of prisons of the kingdom have since been reconstructed, and the remainder (with few exceptions) altered in conformity to the principle recommended by him, namely, *that of introducing currents of fresh air* INTO *and* THROUGH *every apartment.*

In these prisons, where attention is also paid to personal cleanliness, I venture to say, the gaol fever is unknown, unless brought into them by prisoners committed in a state of previous infection.

By equal exertion on the like principles, the healthiness of the ships of war has been so improved, that they are no longer sources of this desolating pestilence.

Regarding hospitals, I fear it cannot be proved that a relief so complete has been effected. Mr. Howard was not sparing in his strictures on the management of this important branch of our public institutions; but the improvement he suggested went no farther than simply

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the introduction of fresh air. The reconciling this advantage with that generally diffused warmth, necessary in sick rooms, seems to have escaped his contemplation.

Of the several hospitals constructed since his observations were made public, most have been planned with a view to facilitate the passage of outward air through the wards. The directors of old hospitals have adopted alterations more or less tending to the same purpose; but all seem to have rested at this point: yet, considering the importance of pure air to patients, during the tedious cure of compound fractures, and other accidents or diseases, together with the no less important object of securing them from currents of cold air, it cannot be denied that much still remains to be effected.

In the construction of the larger work-houses, termed Hundred-houses, similar principles of ventilation have been attended to with evident success, in preserving the health of the inhabitants; but with respect to parish workhouses on the *lesser* scale, school-rooms (both for boys and girls in every rank of life), manufactories, apartments for public lectures, and ladies assembly-rooms, these, together with the circumscribed cottages of the poor, remain in a state most dangerous to health from imperfect ventilation. To these sources, and to no other, may be traced the few putrid and contagious diseases which occasionally show themselves amongst us; and which, to the credit of *free ventilation*, can no longer justly be called gaol or ship fever.

At a period of demonstrated success of the doctrine recommended by Mr. Howard, and adopted by his disciples, the valuable essays and experiments of Count Rumford appeared before the public. Whilst opening to the world a new and most useful system of domestic philosophy, he has advanced opinions unfavourable to those

means

means by which these important effects have been produced.

In theory this ingenious philosopher and friend of mankind has decidedly negatived the necessity, and questioned the propriety, of ventilation, by the admission of currents of air. In the construction of those buildings most immediately under his direction, he has certainly adopted a *practice* of a direct opposite tendency.

Opinions of such authority could not fail to be respected: they must at least raise a doubt in the mind of the most confident advocate of an opposite theory.

As the Count's observations and practices tended to invalidate a material part of that system, in the pursuit of which immense sums had been *confidently* expended in the kingdom, and respecting which I bear more than a common share of responsibility, I felt myself peculiarly called upon to scrutinize his objections, and to obviate such as should appear to be denied by experience; but, at the same time, certainly to abandon whatever ground could not be fairly maintained by a result.

As my conclusions on the point disputed are formed on circumstantial observations made within a prison and hospital immediately under my own eye, and as these particular institutions have not unfrequently been resorted to as examples for imitation, a detailed reasoning regarding them may serve for general application.

The county gaol at Gloucester is constructed on the principles of admitting air to pass into and through it, in strait lines, from one extremity to the other. There is no obstruction to a freedom of current, other than as the streams of air passing through the long passages, open at each end, move with the greater velocity, they of necessity carry with them the weaker currents, passing into and through the cells at right angles.

From

From the time this prison was opened in 1791, until the year 1800, about 1300 persons were committed to it; and, on the average, about 100 prisoners were constantly confined in it. In these nine years the number of deaths has been thirteen; and of these, four sunk under the effects of disease brought into prisons with them. During the last year, the prison has been crowded in an uncommon and very improper degree: two hundred and fourteen have been confined; and the average number has been one hundred and sixty-seven. One prisoner only has died (a woman aged sixty) in the month of October last. At the opening of the spring assizes, 1801, (the time of the greatest numbers) there was not one prisoner sick, or in the hospital ward.

By this statement it appears, that the proportion of deaths is so much below the common average, in the ordinary situations of life, that the healthiness of this abode may be said to be peculiar: and it is in proof, that however currents of air may be found injurious to particular constitutions, they are not unfavourable to general health.

Every prisoner in this gaol, when not in the infirmary-ward, sleeps in a room containing from fifty-two to fifty-seven feet of superficial space, built with brick, resting on an arch, and arched over; so that no air can enter it but through the openness provided for it. As air is constantly passing immediately under it, and round it on every side, it is necessarily dry: it is ventilated by opposite openings near the crown of the arch. To that opening, which is towards the outward air, there is a shutter, which the occupant may close at will; but it is so imperfectly fitted, that, when closed, a considerable portion of air must enter by its sides. The opposite opening

to the passage, the prisoner has no means of closing in any degree.

During the ten years these rooms have been inhabited, there have been three winters in which the cold has been intense. As I had considerable apprehensions of the effects of this situation in severe weather, I directed the surgeon of the gaol to be constant in his attention; and particularly in the report of his observations during the inclemency of these seasons. I also made a point frequently to visit the prison, and to examine every prisoner as to the effects apprehended; and, as much to my surprise as to my satisfaction, notwithstanding the querulous disposition of persons in their situation, I never heard a complaint from old or young, from male or female, suffering by cold in the night apartments *. And farther, it is the decided opinion of the two able physicians who have most liberally undertaken to superintend the health of this prison, that no ill consequences have arisen from prisoners sleeping in the situation above described.

I must contend, therefore, it is a fact established by experience, that in a room containing not more than from 415 to 439 cubical feet of air, in which there is no fire, the body of a person sleeping under a proper allowance of woollen bed-clothes will so far warm the atmosphere around him, or to speak more conformable to modern doctrine, so little of the heat generated in the body will be carried off by the surrounding air, that he will

* Fahrenheit's thermometer has never been observed to be below 38° in the severest nights, in the middle region of a cell in which a prisoner was sleeping; whereas, in the ordinary apartments of a dwelling-house, water is frequently known to freeze by a bed-side.

not

not suffer by a current * passing at a distance over him, provided the apartment be secured from damp. On the points, therefore, of warmth and ventilation *combined* it must surely be allowed (regarding rooms so constructed) there is no farther *desideratum*.

Prisoners, on their rising in the morning, are removed into small working-rooms or wards situated on the ground-floor. These day apartments are, in like manner, constructed with cross openings near the cieling or crown of the arch; but there is also in each of them an open fire-place. Respecting these apartments, my observations tend to *confirm* Count Rumford's objection to open fires, and his preference to closed stoves. Nay, farther, I am disposed to admit, that openings for free ventilation are incompatible with strong fires in open fire-places.

It is certain that, in rooms so provided, the danger arising from impure air is completely guarded against; yet this advantage is gained at the risk of another evil; which, though not so important, should, if possible, be avoided.

The air which in the same room without an open fire-place would pass inwards by one opening, and outwards by the other, being attracted by the fire to supply the consant rarefaction in the chimney, passes inwards from both openings towards the fire place, and the body of a person placed near it, being in its current, is exposed to the danger of partial chill. To this circumstance, in these apartments, I am inclined to attribute the few complaints of a dysentery or aguish tendency, which have occasionally interrupted the general health of this prison.

* The term "current" is not to be understood in a stronger sense than merely to signify that species of circulation of air, which is directed in strait lines from point to point, by the action of any efficient cause.

In the hospital, the scene of my observations, the morbid effects of foul air in the wards have, until lately, been no otherwise relieved than,

First,—By introducing currents of fresh air by the windows, with an improved mode of hanging the upper sash, peculiar to this hospital, by the effect of which the current of air admitted is turned upwards to the cieling, and prevented from descending on the patients, whose beds are placed under the windows;

Secondly,—By piercing holes in the cieling of the wards, and by means of plastered channels or wood funnels, leading the foul air, rising into them, to the roof.

In warm weather, when the doors of the wards are open, and the fires low, these channels or funnels operate with considerable effect. Much foul air will by its relative specific lightness (not being counteracted by a stronger power) ascend them and escape; a farther portion will pass off by the windows opening to the leeward, and ventilation may be duly effected.

But, on the contrary, when the doors are shut, and strong fires are made, these will inevitably attract the currents of air *inwards* and towards them, from all the openings; and should patients be situated in their course, the effect cannot fail to be injurious.

Besides, as the windows are generally closed in the night, (the most important time for ventilation,) no other change of air takes place, but what is effected by the open fires, which, whilst supplied immediately from the middle region, are constantly consuming the best air of the room.

Hence it appears that free ventilation, or the transverse passage of outward air, may be inconsistent with the general warmth required in the apartments of the sick; and that channels for the escape of foul air, unassisted

sisted by a power more constant and decisive than the relative specific lightness of that air, is a mean inefficient to preserving a healthful respiration in the crowded wards of an hospital.

As a remedy to these apparent defects in the ordinary mode of ventilation, it has been imagined that the draft, or determination of the air, to the funnels in the cieling of the rooms requiring ventilation, is accelerated by the operation of fire; and by causing an increased degree of rarefaction, at the termination of the funnel, to discharge the air rising to the cieling in a degree depending on the correct application of the apparatus and quantity of fuel consumed.

In all rooms or apartments requiring ventilation, it is presumed that (according to the old system) channels or funnels are provided for the discharge of air ascending into them. These channels or funnels, so provided, should be rendered air-tight, and brought to terminate immediately under the fire intended to work them. The ash-pit and fire-place should be so closed, by doors, as to prevent the fire from drawing the air from the room surrounding it. The whole draft or consumption occasioned by the fire will then be supplied from the further termination of the channel or funnel.

This effect may be applied according to circumstances, either to the cieling of the room in which the fire is made, to the room below, or to that above it; and draught thus produced may, by a proper apparatus, be increased or diminished at will.

In the hospital in which I have made the first experiment of this design, I have caused a stove to be so formed as to answer the culinary purposes of the ward in which it is fixed, and at the same time to ventilate the ward beneath it; and no additional expense is created in fuel by the operation.

By

By a fire made in one of these stoves, a ward beneath it, containing about 18,000 cubical feet, filled with patients, (and which, in spite of all former means, was ever remarkably offensive,) was in a few minutes so relieved of contaminated air, as to be sensibly felt by all the patients in it, without their perceiving any increased current.

The principle of the means of ventilation adopted in this hospital may be applied with perfect facility to ships.

By carrying the funnel from a cabin or ship stove, of any kind or dimension, (observing *only* to exclude the admission of surrounding air,) to the hold or under-decks, they may be as completely ventilated as the wards of an infirmary. In stormy weather, when the decks of a ship must of necessity be closed, the fires would perform a service which could no otherwise be attained; whilst, by the nature of the apparatus, the fire itself would be secured from the effects of the wind.

If the stove or grate over a lady's drawing-room were properly fitted to this purpose, on the evening of her assembly, it might be set in action, and the room beneath cleared of its impure air, without recourse being had to the openings of windows: the openings in the cieling might be rendered ornamental.

By applying the same principle to German or other closed stoves, the chief objection to their use in crowded rooms would be obviated; and I should then agree with Count Rumford, that in all rooms, where the indulgence of the habit of open fires was not in question, such stoves (if constructed of earthen materials) would afford a more "genial warmth," and a "due circulation be at the same time effected."

So

So fitted and constructed, they would be incontestably better than open fires for the wards of hospitals, poor-houses, manufactories, theatres for lectures, school-rooms, and prisons. Respecting the last-mentioned structures, I must farther observe, that if public kitchens were a sutler appointed, under due regulations, the present necessity of open fires for prisoners to cook individually for themselves, would be superseded much to their advantage.

On the other hand, I must also observe, that if closed stoves, acting on this principle, were adopted, Count Rumford's objections to the introduction of fresh air would be obviated, with regard to any room in which they should be in action, provided the opening through which it entered was made on a level with the cieling.

Air entering at this level would, in the absence of open fires, be acted upon by no other draft than the mouth of the funnel in the cieling, and could not descend in currents to the lower region of the room.

In a room so filled with company as to vitiate the air within it, the atmospheric air entering, being specifically heavier, would indeed descend, and be replaced by the ascending impure air; but, as it would not descend by a stronger impulse than its difference of specific weight, it must be slow in its motion, and would produce no sensible current.

References to Plate XII.

Fig. 1, a perspective view of the Stove, for ventilating the wards of hospitals.

A A, a chimney-piece, of ordinary dimensions.

B, a bath-stove, made to fit the chimney: the hobbs of which, N, N, project two inches and a half before the fire-grate.

C, C,

C, C, folding-doors to close the fronts of the ash-pit, and to fall back against the hobbs.

D, D, folding-doors to close the front of the fire-grate, and to fall back against the hobbs.

E, a door to close the top of the fire-grate, when a very strong draught is required. When put down, the smoke is directed through the open space H, and the door is used as a hot table for culinary purposes; when open, it serves as a chimney back.

F, a flat bar, projecting two inches and a half before the fire-grate, as a stop to the upper and lower doors.

G, G, holes left in the castings of the ash-pit, to receive the mouths of air-tunnels in the back, or on either side, as circumstances may require.

H, the opening to the back flue, used as a passage for the smoke, when the top door is closed on the fire-grate.

I I, a double register: first, to close the back flue when the fire-grate is open; secondly, to close the front flue when the back draught is necessary; and, thirdly, to prevent the heat being carried up the chimney.

Fig. 2, a back view of the ventilating stove, on which similar letters are marked as denote the same parts already mentioned in Fig. 1.

K, K, are shoulders for tunnels, cast with the ash-pit, fixed at the openings G, G, mentioned in Fig. 1.

N. B. There should be doors or regulators to the mouths of the air-tunnels K, K, to close them when the doors of the stove are open, otherwise (there being at that time little or no draught by the tunnels towards the fire,) the dust will pass by them into the rooms with which they communicate.

L, L, air-tunnels are to be fixed on the shoulders K, K, and to be prolonged in any direction required, either downwards

downwards to any room below, which wants ventilating, or upwards to the cieling of the room in which the fire is made, or to any rooms above it requiring ventilation.

N. B. The direction of the first length or piece of the tunnel should, in all cases, be upwards, to prevent sparks of fire, which may fly into it, being conveyed into a room ventilated by a descending tunnel.

The tunnel should, at least, rise so far that the lower edge of it may be higher than the upper edge of the shoulder on which it is fixed.

M, a back flue, to conduct the smoke when all the doors are closed, and the stove made to act with its utmost force.

N, N, the hobbs on each side the fire-place.

Fig. 3, side view of the ventilating stove, in which the letters correspond as before.

Fig. 4, view from above of the two chimneys which convey away the smoke, and of the register which closes one or other of them, as occasion may require.

Fig. 5, *a a a a*, a common sash-window frame, the upper extremity of which should be level with the cieling of the room.

b, the lower sash fixed.

c, the upper sash, working inwards on the pivots *e*, *e*, at each side of its lower end.

d, *d*, inclined edges fixed, with a proper inclination inwards, on the jambs to which the sash is fitted. These jambs and ledges should be made as exactly as possible to fit the sash in its working, to prevent air from passing inwards by its sides.

e, *e*, the pivots on which the upper sash-frames move.

f, a regulator, notched on its lower part, and moving in a groove *g*. At the extremity of the regulator is a loop or ring *h*, to receive a hook fixed to a long pole, by

 which

which the sash may be worked by the apothecary or nurse. The notches in the regulator resting on the groove, admit the sash to be placed at any intermediate distance required.

The pole may be afterwards removed out of the reach of the patients.

Experiments and Observations on the Power of Fluids to conduct Heat; with Reference to Count Rumford's Seventh Essay on the same Subject. By JOHN DALTON.

From the MEMOIRS of the LITERARY and PHILOSOPHICAL SOCIETY of MANCHESTER.

THE nature and properties of fire or heat are subjects which present themselves to our consideration in almost every department of physics; it is no wonder, therefore, that new experiments, which point out and define the modes of operation of fire, before unobserved, or at least too much overlooked, should attract the attention of philosophers. These observations were suggested upon reading Count Rumford's very ingenious experiments, in his essay abovementioned, which exhibit a fact in a more striking point of view than it has appeared before—namely, *that the quickness of the circulation and diffusion of heat in fluids, is occasioned principally by the internal motion arising from a change of specific gravity effected by the heat.*—But the conclusion he has drawn from them—*that fluids are perfect non-conductors of heat*, in the way in which solids conduct it, appears to me totally unwarranted from the experiments, and erroneous in itself. And as it may be an error of practical consequence, if adopted, the exposition of it seemed desirable—which is the object of the following remarks and experiments.

My

My first attempt was to ascertain the precise degree of cold at which water ceases to be farther condensed—and likewise how much it expands in cooling below that degree to the temperature of freezing, or 32°. For this purpose I took a thermometer tube, such as would have given a scale of 10 inches with mercury from 32° to 212°, and filled it with pure water. I then graduated it by an accurate mercurial thermometer, putting them together into a basin filled with water of various degrees of heat, and stirring it occasionally: as it is well known, that water does not expand in proportion to its heat, it does not therefore afford a thermometric scale of equal parts, like quicksilver.

From repeated trials agreeing in the result, I find, that the water thermometer is at the lowest point of the scale it is capable of, that is, water is of the greatest density at 42°½ of the mercurial thermometer. From 41° to 44° inclusively the variation is so small as to be just perceptible on the scale; but above or below those degrees, the expansion has an increasing ratio, and at 32° it amounts to $\frac{1}{8}$th of an inch, or about $\frac{1}{180}$th part of the whole expansion from 42°½ to 212° or boiling heat.—During the investigation of this subject, my attention was arrested by the circumstance, that the expansion of water was the same for any number of degrees from the point of greatest condensation, no matter whether above or below it: thus, I found that 32, which are 10°½ below the point of greatest density, agreed exactly with 53°, which are 10°½ above the said point; and so did all the intermediate degrees on both sides. Consequently when the water thermometer stood at 53°, it was impossible to say, without a knowledge of other circumstances, whether its temperature was really 53°, or 32°. Recollecting some experiments of Dr. Blagden in the Philosophical Transactions, from which it appears that water was

cooled down to 21° or 22° without freezing, I was curious to see how far this law of expansion would continue below the freezing point, previously to the congelation of the water, and therefore ventured to put the water thermometer into a mixture of snow and salt, about 25° below the freezing point, expecting the bulb to be burst when the sudden congelation took place. After taking it out of a mixture of snow and water, where it stood at 32° (that is 53° per scale) I immersed it into the cold mixture, when it rose, at first slowly, but increasing in velocity, it passed 60°, 70°, and was going up towards 80°, when I took it out to see if there was any ice in the bulb, but it remained perfectly transparent: I immersed it again and raised it to 75° per scale, when in an instant it darted up to 128°, and that moment taking it out, the bulb appeared white and opake, the water within being frozen: fortunately it was not burst; and the liquid which was raised thus to the top of the scale was not thrown out, though the tube was unsealed. Upon applying the hand, the ice was melted and the liquid resumed its station. This experiment was repeated and varied, at the expence of several thermometer bulbs, and it appeared that water may be cooled down in such circumstances, not only to 21°, but to 5° or 6°, without freezing, and that the law of expansion abovementioned obtains in every part of the scale from 42°½ to 10° or below; so that the density of water at 10° is equal to the density at 75°. But as the discovery of this curious, and I believe hitherto unnoticed property, has little to do with the object before us, I shall say no more of it at present.

Count Rumford's principal experiments are those in which a cake of ice was confined on the bottom of a cylindrical glass jar, of 4.7 inches in diameter, and 14 high, and water poured upon it of different temperatures suffer-

ing

ing it to stand, without agitation. He found that about 6lb. of boiling hot water melted little more ice than as much water of 41°; and that by making such allowances as the experiments seemed to warrant for deductions when hot water was used, water of 41°, or 9° above the freezing point, melted quite as much, and often more, than the hot water: from which he infers, that water, and by analogy all other fluids, do not transmit heat in the manner that solids do, but circulate it solely by the internal motion of their particles.

The existence of this internal motion he has proved decidedly; that water of a certain temperature being of the greatest density, will always take the *lowest* place, and water either warmer or colder than that degree will ascend. This degree of greatest condensation he takes, on the authority of others, at 40°; it appears, however, from the experiment related above, to be still more favourable to his position, namely, 42°½: and that water of 32° must ascend till it comes to water of 53°, if it be not cooled in its progress, which circumstance he admits.

Upon considering the facts related in his experiments therefore, there are *three* causes which suggest themselves, as conspiring to circulate and diffuse the heat, by which the ice is melted.

1st. The internal motion of the liquid, by which water of 32°, incumbent upon the ice, is perpetually ascending into a warmer region of 53°, and warmer water of 42°½ descending to take its place.

2d. The proper conducting power of the liquid independent of internal motion.

3d. The conducting power of the glass jar. But as glass is known to be a very bad conductor of heat, it can produce no material effect in these experiments: for which

which reason Count Rumford does not appreciate the third cause.

With respect to the operation of the first cause, it will *generally* be supposed, that *cold* water rising into *warmer* and remaining with it, the heat is impaired, and the two reduced to a common temperature. But Count Rumford does not admit of this communication; he maintains, that the two still retain there proper share of heat, notwithstanding they are mixed together. This hypothesis of his is of no peculiar consequence as far as respects the effect of the internal motion: for the temperature indicated by a thermometer immersed in an equal mixture of water at 32° and 53°, would be the same as if the water was uniformly of the temperature 42°½. But it has material consequences in other respects; for, if it be admitted, it annihilates the *second* cause abovementioned, and it would follow that warm water being put upon cold water above the temperature of 42°½, the heat could not in any degree be propagated downwards, unless by agitation, and even then, upon subsiding, the warm part ought to rise to the top, and the cold fall to the bottom.

These positions are so manifestly contradictory to common opinion, that they cannot be received without proof. But Count Rumford has not given us a single experiment to prove them. It seemed necessary, therefore, to clear up this point by direct experiments.

Experiment I. Took a large tumbler glass, 3½ inches diameter, and 5 inches deep, and filled it half way with water of 51°, then gently filled up the rest, by means of a small syphon, with water of 88°; a thermometer, with its bulb and stem detached from the frame, being previously immersed to the bottom. The temperatures at the top and middle were had by gently immersing the bulb of another thermometer into the water.

Time

Time elapsed.	TEMPERATURE, *at top.*	*in the middle.*	*at bottom.*
——	88°	——	51°
5 min.	85	——	54
12	82	75°	56
18	80	72+	58
30	76	——	60
40	73	——	61
50	70	——	61
60	69	——	61

(Air in the room 50°).

Experiment II. The same as before; only a circular piece of wood floated upon the surface of the water, on the centre of which the stream of the syphon was directed to prevent the current downwards.

(Air in the room 55°.)

Time.	TEMPERATURE. *at top.*	*at bottom.*
Before the water was poured on		56°
——	116°	56+
10 min.	105	$56\frac{1}{2}$
20	92	57 —
30	85	$57\frac{1}{2}$
40	80	$57\frac{3}{4}$
50	77	58+
1 h. —	75	$58\frac{1}{2}$
— 10 min.	$72\frac{1}{2}$	$58\frac{1}{2}$
— 20	70	59—
— 30	67	$58\frac{1}{2}$
— 40	65	58+
— 50	63	58
2 —	62	58—
— 15	61	$57\frac{1}{2}$
— 30	$59\frac{1}{2}$	57

TEMPE-

	TEMPERATURE.	
Time.	*at top.*	*at bottom.*
3 —	$57\frac{1}{2}$	56 (Air 52°)
5 —	$53\frac{1}{2}$	53 ditto.

A similar result was obtained in a different way by the following.

Experiment III.—Took an ale glass of a conical figure, $2\frac{1}{2}$ inches in diameter and 3 inches deep; filled it with water that had been standing in the room, and consequently of the temperature of the air nearly—Put the bulb of a thermometer to the bottom of the glass, the scale being out of the water: then, having marked the temperature, I put the red-hot tip of a poker half an inch deep into the water, holding it there steadily about half a minute; and as soon as it was withdrawn, I dipt the bulb of a sensible thermometer into the water about $\frac{1}{4}$ inch, when it rose in a few seconds to 180°.

		TEMPERATURE,	
Time.	*at top.*	*middle.*	*at bottom.*
Before the poker was immersed			47°
—	180°		47°
5 min.	100	60°	$47\frac{1}{2}$
20	70	60	49
1 h.—	55	—	52

These experiments all evidently agree in proving water to have a proper conducting power, independent of any internal motion.—It surely will not be said that any slight motion, unavoidably made at the beginning of an experiment, could continue with a powerful effect for upwards of an hour. However, to determine this matter, I made the two following experiments.

Experiment IV. Took the glass tumbler of the first experiment, and filled it half way with rain water, deeply tinged with archil; then filled it up with clear warm water,

ter, as related in the 2d experiment. The upper half was but just perceptibly tinged by the process and uniformly so; it remained for an hour not visibly altered in this respect; though by frequently putting the bulb of a thermometer down to the middle, the colour at last rose in a small degree.

(Air 45°)

TEMPERATURE.

	at top.	*middle.*	*bottom.*
Before the warm water was poured on	. . . . .	. . . . .	44°
Time.	105°	—	—
7 min.	97	—	47+
17	86	—	48
27	79	—	49+
37	75	68	50
47	70	66	50+
57	66	62	51½
1 h. 7	60	62	51½
— 17	60+	59	51½
— 27	59	—	51½

Experiment V. A glass tube near an inch in diameter, and 16 inches long, was half filled with a coloured solution of common salt in water, warm; a small thermometer was wholly immersed in it, and cold clear water carefully poured upon the whole, so as to fill the tube; the colour ascended very little, and continued invariable after the process of filling. The warm solution was of course made of greater specific gravity than the cold water.

(Air 45°)

TEMPERATURE.

	at top.	*bottom.*
Time.	45°	85°
5 min	53	79
10	53	74

	TEMPERATURE.	
Time.	*at top.*	*bottom.*
21	52	69
31	51	66
45	$50\frac{1}{2}$	64
58	50	61
1 h. 31	49	$56\frac{1}{2}$
3 30	47	51
— 55	47	50
4 15	—	49
7 5	46	48

To determine whether hot and cold water being suddenly mixed, and agitated, the hot would afterwards rise to the top, was the object of

Experiment VI. Air in the room 50°. About ½ pint of water of 130° was poured into a cold tumbler glass, and immediately after as much water of 50°; the mixture was agitated for half a minute by a deal rod; after which an immersed thermometer stood at 85°, both at top and bottom; it was then set by in a still place for examination.

	TEMPERATURE.	
Time.	*at top.*	*bottom.*
15 min.	$77^{\circ}\frac{1}{4}$	77°
30	73	$72\frac{2}{3}$
45	68	$67\frac{2}{3}$
1 h. —	64.8	64.6

From all these experiments it is evident, that water has a proper conducting power. In the last experiment, if the particles of water during the agitation had not actually communicated their heat, the hot ones ought to have risen to the top, and the cold ones subsided so as to have made a material difference in the temperature.—It is, however, equally evident, that water is a *bad conductor* of heat, probably as it is of electricity; the descent of the

heat

heat in the second experiment is wonderfully slow; a slight agitation for one *second* would do as much to induce the equilibrium as standing still one *hour*. In repeating the third experiment, in a wine glass, I have several times known water ½ an inch deeper to differ 50° in temperature from the incumbent water.

We must conclude, therefore, that the quick circulation of heat in water over a fire, &c. is owing *principally* to the internal motion excited by an alteration of the specific gravity; but not *solely* to that cause, as Count Rumford has inferred.

If it be proved that water conducts heat, it will scarcely be necessary to prove, that other fluids conduct it, and that they communicate it one to another:—the two following experiments shew that mercury conducts it, and that water and mercury reciprocally communicate it.

Experiment VII. Took a cylindrical glass tube, of 1 inch internal diameter, and put 1¾ inches in depth of mercury into it, and immersed the bulb and stem of a thermometer to the bottom, the scale as usual being above the liquid; then put 2¼ inches of warm water upon it by a syphon, and let it stand without agitation.

TEMPERATURE.			TEMPERATURE.		
	Merc.	*Water.*	*Time.*	*Merc.*	*Water.*
Time.	56°	122	14 m.	74°½	92°
3 m.	70	118	19	73	87
6	73	110	27	71	78
11	75	100			

Experiment VIII. Into a tumbler glass, 2½ inches in diameter, poured an inch in depth of mercury, and heated it to 110°; upon which was poured an inch of water at 50°, and then kept still.

	TEMPERATURE.	
	Merc.	*Water.*
Time.	110°	50°
4 min.	74	70
8	71	70½
10	70½	70

Finding that water was so bad a conductor of heat, I was desirous to learn how ice would conduct it, and tried it as follows.

Experiment IX. Feb. 9th. Out of a mass of ice, by means of a hot iron, I shaped a cylindrical piece, 3 inches in diameter, and 5½ inches long, clean and pure; its weight 17 ounces. Made a small round hole at one end, one inch deep, and the size of a thermometer bulb, which was inclosed in it. The other end of the piece was put into a bason of snow and salt, to the depth of from ½ to 1½ inches, the temperature of which was kept below 10° for 1¾ hours. Air 37°.

Time elapsed.	*Therm. in the liquid.*	*Therm. in the ice.*
	5°	32°
1¾ h. at a medium.	7	31½

N. B. This descent of half a degree was gradual, but did not commence till long after the beginning of the experiment. After this the piece of ice was inclined to one side, by which nearly one half of it was immersed in the cooling liquid, and the inclosed bulb of the thermometer was now not more than an inch from the cold mixture.

h. m.	*Therm. in the liquid.*	*Therm. in the ice.*
1 50*	14°	28°
2 20	19	28
2 50	22	Ice along with the therm. slipped down into the cold liquid.

* From the beginning of the experiment.

The

The ice now weighed $12\frac{1}{2}$ ounces: the rest had been liquified by the operation of the saline liquor.

This experiment, I think, decidedly proves that ice is a worse conductor of heat than water. Indeed this is not wonderful; for it is said, that ice at a low temperature becomes an electric.

It is certainly a remarkable circumstance, but not at all inconsistent with the known laws of heat, that in a mixture of hot and cold liquids the uniform temperature should be so soon induced by agitation and so slowly by rest: but when we consider, that in the former case hot and cold particles are brought together, and that in the latter there is a series of particles one upon another, gradually rising in temperature, but differing by insensible degrees, we shall not wonder at the facts. When any one particle of water, or any other body, has one above it, warmer by an insensible degree, and another below it, colder by an insensible degree, its power to transmit heat must be very small. These considerations gave rise to the two following experiments.

Experiment X. A mercurial thermometer was taken, its bulb $\frac{4}{10}$ inch in diameter, and hanging clear of the scale. It was heated by the flame of a candle to 600°, and then laid upon a table with the bulb projecting over the edge, and was thus left to cool by the mere operation of the air in the room, which was 52°. The following is the medium result of two experiments, which, however, agreed with each other almost in every observation.

Time.	*Temp.*	*Time.*	*Temp.*
0	600°	18 half m.	66°
1 half m.	450	19	64
2	350	20	62
3	280	21	60
4	229	22	59

Time.

Time.	*Temp.*	*Time.*	*Temp.*
5	195	23	58
6	168	24	57
7	145	25	56
8	128	26	55
9	115	27	54
10	104	28	53+
11	95	29	53
12	88	30	53
13	81	31	53
14	77	32	52+
15	73	33	52
16	69+	Air in the room	52
17	68		

Experiment XI. Another thermometer, having a similar bulb, but a scale with much larger degrees, was heated and cooled in the same manner.

Time.	*Temp.*	*Time,*	*Temp.*
—	85	16 half m.	56.3
1 half m.	$79\frac{1}{2}$	17	$56\frac{1}{2}$
2	75	18	56
3	71+	19	55.9
4	$68\frac{1}{2}$	20	55.7+
5	$66\frac{1}{3}$	21	55.6+
6	$64\frac{1}{2}$	22	55.5
7	63	23	55.4
8	$61\frac{1}{2}$	24	55.3
9	60	25	55.25
10	59	26	55.2
11	$58\frac{1}{4}$	27	55.1+
12	58	28	55.1—
13	$57\frac{1}{4}$	29	55.+
14	57	30	55
15	56.6		

In

In these experiments we may consider mercury and air mixed together of unequal temperatures, with a thin partition of glass—and from the last we may conclude, that the thermometer imparted to the air 40 times more heat in half a minute, when its temperature was 30° above the air, than when it was only 1° above it.

We shall now advert a little to Count Rumford's experiments.—It will easily appear, that arguing fairly upon his own hypothesis he can never account for the phenomena observed: for, hot water being poured upon ice, an internal motion would take place near the surface of the ice, by which a stratum of water of a certain thickness would be reduced to 32°, and then all further reduction of the ice must cease; because all the superincumbent water, being above 53°, would be lighter, and could not descend to the ice. But this is quite contrary to what took place. The facts, however, will admit of a satisfactory explanation upon established principles.

By experiments X. and XI. it appears, that the quantity of heat given out by a body, during any small given portion of time, is nearly as the excess of the temperature of the body above the cooling medium. Hence, then, we may conclude, that the effect of hot water upon ice, arising from the proper conducting power of water, will be nearly as the heat of the water. What effect the other cause may produce, it will be difficult to determine from theory: experience will be the best guide. One thing, however, appears pretty certain, that its effect must be a *maximum*, when the temperature of the water at large is 42°½; because then there can never want a determination of the particles *downward*, to supply the place of the lighter water of 32° degrees ascending. If the temperature of the water exceed 42°½, then the effect of the

internal

internal motion will be less, diminishing by some unknown ratio. As far as I can judge from Count Rumford's experiments, the joint effects of these two causes should be nearly the same with water of 42° and water of 190°. Taking this, therefore, for granted, we shall be enabled to sketch a table of the values of those two causes for every 10° of temperature. The numbers expressing the effect of the proper conducting power, are derived from the tenth experiment, and consequently are not purely hypothetical: those expressing the other effect, except 42° and 192°, are put down hypothetically, because the law of decrease has not been ascertained.

It is to be supposed, that a given quantity of water, of the several temperatures mentioned, is carefully poured upon a cake of ice, at the bottom of a cylindrical glass jar, and stands without agitation for a given time, as half an hour; then the proportionate quantity of ice supposed to be melted by the two causes separately are stated in numbers, and then the sums are taken to express the joint effects.

Temperature

Temperature of the Water on the Ice.	32.°	42.°	52.°	62.°	72.°	82.°	92.°	102.°	112.°	122.°	132.°	142.°	152.°	162.°	172.°	182.°	192.°	202.°	212.°
Ice melted by the conducting Power of the Water.	0.	2.	3.	6.	9.	11.	12.	14.	17.	19.	21.	23.	25.	27.	30.	33.	35.	38.	40.
Ice melted by the internal Motion of the Particles of water.	0.	36.	35.	31.	25.	19.	16.	14.	12.	10.	8.	7.	6.	5.	4.	3.	3.	3.	3.
Total Quantity melted by both Causes.	0.	38.	38.	37.	34.	30.	28.	28.	29.	29.	29.	30.	31.	32.	34.	36.	38.	41.	43.

After

After what has been said, I need not caution my readers not to consider this table as accurate. The principle of it, however, cannot, I conceive, be disproved: that the operation of the conducting power must be proportionate to a series of numbers beginning from 0 at 32°, and gradually increasing, in some ratio, with the temperature above 32°, cannot, I think, be controverted; and that the operation of the internal motion must begin from 0 at 32°, and increase till it arrives at its *maximum* at 42°½, and then decrease again ever after, is also, I apprehend, unquestionable; thus, when the jar had water of 42°, in Count Rumford's experiments, this internal motion must have had a range of eight inches in depth; whereas, when hot water alone was used, it had not more than three-fourths of an inch to range from the temperature of 32 to that of 53°.

The following table exhibits a concise view of all the material varieties of Count Rumford's experiments, with their result.

Experiment

	Temperature of the Water when poured on the Ice. At the Beginning.	At the End.	Medium Temperature.	Water in the Jar surrounded by		Ice melted in 30 Minutes.
Experiment 32	41°	40°	$40\frac{1}{2}$°	Air	41°	617 Grains.
35	189	180	$184\frac{1}{2}$	*a warm covering of cotton wool.*		747
38	41	43	42	Air	61	676
39	180	157	$171\frac{1}{2}$	Air	61	559
45	188	64	128	Ice and Water	32	406
51	61	49	55	Ice and Water	32	660
53	61	60	$60\frac{1}{2}$	Air	61	642

Count

Count Rumford attempts to explain why there was less ice melted in such experiments as the 45th than in those like the 39th, and attributes the diminution of the effect to the descending currents, occasioned by the cold mixture surrounding the warm one, which he thinks would obstruct the opposite ones ascending from the ice. But the effect in the 51st compared with the 53d, being just opposite, he passes over without explanation.—I have no doubt myself, but that the true cause of the differences in both cases, is to be found in the column expressing the *mean temperature* of the water, and not in that expressing its situation, which I consider as having nothing to do in the business, but as it affects the general temperature. The *maximum* effect with cold water will be when it is of the temperature of about 48° or 50°, and the *minimum* above is probably about 100° or 120°; and in proportion as the mean temperatures, in any experiment, deviate from those points, the effects vary accordingly, let other circumstances be what they may.

Thus I have attempted to explain the rationale of these very curious and interesting experiments, in a manner different to what their ingenious author has done. And must now leave it to the reader to form his opinion.

An

An Account of Experiments on the Culture of Beans and Wheat in one Year on the same Land. By Mr. ROBERT BROWN, *of Markle, near Haddington, in Scotland.*

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

The Silver Medal was presented to Mr. BROWN *for this Communication.*

I TAKE the liberty of transmitting to you an account of eighty-eight and a half acres of land, drilled with beans in the months of February and March 1798; amongst which a few peas were mixed, in order to improve the straw as fodder for horses, and for making ropes to tie the crop. The whole of the said land was sown with wheat in the month of October, the same year. I shall shortly state the mode of managing the beans.

The land was first cross-ploughed during the preceding winter, and about 20 acres were dunged previous to this furrowing being given, and 10 acres more in the spring, when the beans were drilled. The quantity of dung applied to the acre was about 12 cart-loads, each drawn by 2 horses, the weight of which might be about a ton. The land at seed-time was clean ploughed over, and the drill-barrow followed every third plough, which gave an interval between the rows of 26 or 27 inches. The quantity of seed sown was from 17 to 19 pecks *per* acre, as those who managed the drill sometimes, from inattention, allowed it to sow a degree thicker at one time than another. The kind of beans sown was the common horse-bean, mixed, as I have already said, with a trifling quantity of peas; and the average produce *per* acre of the whole fields sown was nearly 36 bushels *per* acre, the produce

duce being altogether 3,259 bushels, Winchester measure. They were reaped from the first to the middle of September, and the straw was used for supporting the working horses during the winter-months.

It is now proper I should explain my method of cleaning or ploughing the land, when the crop was on the ground, which was effected by a one-horse plough, without any hand-hoe being used. I first harrowed it completely before the beans appeared above ground, and water-furrowed and griped it. As soon as the beans would stand the plough a gentle furrow was given, and women were employed to turn any of the earth from the plants which might have been thrown upon them. Every succeeding furrow was taken deeper, and the last was used for laying the earth up close to the plants, which I consider as of great importance. They were ploughed four times; and I estimated the whole expense of cleaning them at 4*s. per* acre, and that of drilling and harrowing at 1*s.* 4*d.* In no other way can the ground be cleaned at a less expense.

The soil upon which they were sown was a loam of different varieties. I have for many years practised this mode of husbandry for raising beans, which have uniformly been succeeded by wheat; and this year I have 110 acres, all managed in the way described.

In the months of February and March 1800 I sowed with beans, according to the drill husbandry, 4 fields, consisting of 89 acres, 3 roods, and 6 poles, English statute measure, which were succeeded by wheat, sown in the month of October following.

The soil upon which these crops were raised was chiefly of that variety generally characterised as heavy loam, though part of it approached to a soft loam; and nearly the whole was incumbent upon a bottom retentive

of

of moisture. Owing to the uncommon wetness of the autumn and winter months, I was prevented from giving the ground more than one ploughing, except one field, consisting of 19 acres nearly, which was first cross-ploughed, and afterwards ploughed in length. The remainder was sown with beans, the intervals between the drills being 27 inches, in the months of February and March, 1800, after one ploughing; and the whole 89 acres were managed afterwards in the following manner:

The ground was completely harrowed before the plants appeared above ground, and ploughed with one horse as early as the beans were able to stand the operation. This ploughing was repeated about two months afterwards, and so on as often as was necessary. The whole was ploughed four times during the summer months, and a part had five ploughings; and a picking of annual weeds by the hand was given to one of the fields. The total expense of drilling, horse-hoeing, and hand-picking, amounted to about 5*s.* *per* acre, upon an average.

The kind of beans sown was the common horse-bean, mixed with a few peas, which were the best part of the crop. The season during the whole of the year 1800 was remarkably dry, which stunted the crop on the outset. The plants were therefore very short, and the produce when thrashed was only 18 Winchester bushels *per* acre; though I am convinced, if a greater portion of peas had been mixed with the beans, the return would have been much superior.

The ground, after carrying beans, was in excellent order; and, without any dung, yielded me a fine crop of wheat in 1801. The wheat was sown after one ploughing, in the month of October 1800.

Observations

Observations on the Decomposition of Acetite of Lead by Zinc in a metallic State.

By L. Antoine Planche, *Apothecary of Paris.*

From the Annales de Chimie.

In consulting the different authors who have treated of the history of metals, and their chemical action on the different productions of nature, we cannot but consider zinc as extremely valuable, as well on account of its utility in the arts, as for the essential services which it daily renders to chemistry.

Mr. Fourcroy, who in his *Systéme des Connoissances Chimiques* has collected the most numerous and the most authentic facts of the science, has described all its properties with that perspicuity and scientific accuracy peculiar to himself.

It is therefore not so much a new fact which I now submit to the Society, as the developement of that fact which, forming a part of a general theory, deserved a separate consideration, as one of the most important chemical phenomena. To proceed with the greater regularity, I think it necessary to refer to the work of the above-mentioned celebrated chemist; where, in the sixth section on metals, under the article zinc, it is said, "that zinc decomposes a great number of salts and metallic solutions by its powerful attraction for oxygen; that it precipitates the metals from them under a metallic form, or under that of oxyds, less oxydated than they were before."

This definition is doubtless just, and appears perfectly satisfactory. Yet it is capable of being developed to a far greater extent, and particularly in what relates to the

different

different phenomena produced by zinc in contact with acetite of lead. To collect those phenomena is the principal object of these observations; to which I was led by the result of a most admirable experiment, attributed to Dr. Black, communicated to me in the year 1800, and to which I have made some additions.

This experiment of the Scotch chemist is as follows: into a quart decanter put 4 or 5 ounces of crystallized acetite of lead. Fill the decanter with common water, and shake the mixture. Then let it stand 15 or 20 minutes, or till the greatest part of the superabundant salt, after saturation of the liquor, be precipitated. In this solution, slightly agitated, suspend a piece of zinc of an indeterminate weight, by means of a silken or other thread fastened to the stopper of the decanter. Place the vessel in a proper place, and particularly where it will not be liable to be shaken. In 20 or 25 days the decomposition is completed: the zinc suspended in the midst of the liquor, then become transparent, is covered with a kind of metallic vegetation, of a very brilliant appearance, which frequently shoots to the bottom of the decanter, and is denominated by Dr. Black, the Tree of Saturn.

I have had occasion to repeat this experiment very often. It led me to various observations, in consequence of which I determined to make some slight alterations, which interfering in no respect with the chemical nature of the operation, eminently contribute to the beauty of the result. The alterations relate principally to the linen and silk threads, the decay of which, in consequence of their immersion in the liquor, occasions the fall of the piece of zinc, together with the new metal which covers it. In the place of those two kinds of thread I have refore substituted brass wire, which appears to me to possess all the necessary properties, as well from its soli-

dity as its superior power of attraction over acetite of lead, owing to the zinc it contains. A second inconvenience occurs in strictly following the process described above. It frequently happens, that when the piece of zinc is too large, or the form of the vessel is not exactly suitable, the decomposition is effected with extreme rapidity, the particles of the new metal fly precipitately to the zinc, adhere to it in a confused manner, and in 2 or 3 days, sometimes in 24 hours, the crystallized portion is suddenly detached, and falls to the bottom of the vessel, to make room for a fresh crystallization. Thus the operation is divided into several distinct parts, which is perfectly indifferent in a chemical view, but greatly diminishes the interesting effect of this beautiful experiment.

I prevented this inconvenience, by fixing perpendicularly to the bottom of the piece of zinc, the same kind of brass wires, turned in a spiral direction, and disposed in such a manner as to reach within about an inch of the bottom of the vessel.

By adopting this modification, every particle of zinc, composing part of the brass, the surface of which is in contact with the saturation, is covered with an infinite number of small and very brilliant metallic laminæ, disposed at first alternately and horizontally, and which afterwards cross each other in every direction *.

The quantity of acetite of lead must however be diminished, when the brass, although covered with the metal,

* The configuration of these laminæ is infinitely varied, which appears to be occasioned, 1st. by the form, and different dimensions of the vessels in which the operation is performed; and, 2dly, perhaps likewise by quantities of zinc and acetite of lead employed in it. I have seen these laminæ sometimes circular, sometimes hexagonal, and sometimes even approaching the figure of fern or oak leaves.

tal, is wished to be preserved in the form originally given it.

It is about six months since I repeated this experiment, with common and distilled water, with the intention of examining the produce of them. Of this examination I shall endeavour to give an account.

Having selected two decanters, of equal capacity, I put into each 4 decagrammes of crystallized, and very pure, acetite of lead. After marking the two vessels with the numbers 1 and 2, I poured into the first 54 decagrammes of common water, and the same quantity of distilled water in the second. These quantities were sufficient to fill both decanters as high as the neck, the length of which was about 3 centimetres. I then fixed to the two corks that were to be put into them a piece of zinc, weighing 22,9456 grammes, by means of an extremely fine brass wire, and long enough to allow the metal to be immersed only a few millemetres in the solution.

I afterwards adjusted, and carefully luted to the orifice of the vessels, a curved tube, which conducted to the receiver of a hydro-pneumatic apparatus. These two experiments, begun on the 29th Thermidor, year 9, the centigrade thermometer being 14° above 0, presented the following phenomena.

Six hours after the disposition of the apparatus, the liquor in the decanter No. 1 was still turbid, whilst that in No. 2 was transparent; and all the superabundant salt, after the saturation of the liquor, was precipitated. At the same time the zinc in the latter decanter was covered with small metallic scales, which could not be perceived in the former.

The following day the two liquors were both perfectly transparent, and the decomposition appeared to have

Rr 2 made

made equal progress in both vessels. The only remark I made was that the inside of the decanter No. 1 was lined with a white saline coating, which extended from the middle to the bottom of the vessel. The small laminæ fixed on the sides and bottom of the piece of zinc had, as they augmented in magnitude, assumed the form of a full-grown fern-leaf in the decanter No. 1, and of a very small one in No. 2.

I likewise remarked, on the upper surface of the piece of zinc, a kind of metallic moss*, having the livid appearance which characterises sheet-lead exposed to the air for any length of time. The saline coating of No. 1 diminished gradually till the eighth day, when it totally disappeared. During the two experiments a very small portion of elastic fluid was disengaged, which when examined was discovered to be atmospheric air. The quantity from the apparatus No. 1 was rather the largest; and this appeared to me to proceed from the common water, which always contains more or less. The remainder of the operation exhibited nothing remarkable, excepting the augmentation in bulk of the reduced metal, till the complete decomposition, which took place in the experiment with distilled water, the 16th Fructidor, year 9, and in that with common water the 24th of the same month. The temperature varied only one or two degrees at most during the whole time.

* The metallic moss mentioned in this place, was covered in the instance of a tree of Saturn, prepared about a year before, with a fine red powder, which occupied at the same time the surface of the zinc, and that of a portion of acetite of lead not decomposed, and which lay upon the horizontal bottom of a crystal vase. I consider this red powder as produced by the carburet of iron, from which zinc is never exempt; and which is reduced to the state of carbonate during the operation.

As

As in the rest of the operation the results appeared the same, I shall pass to an examination of the experiment made with distilled water.

1. The piece of zinc, weighing 22,9456 grammes, before its immersion in the liquor, was entirely stripped of all the metal with which it was covered. In this state it weighed only 15,9345 grammes. Its surface was covered with a grey, pulverulent coating, the greatest part of which still retained its metallic lustre, whilst the other appeared to have already undergone the commencement of oxydation. When quite stripped of this covering, which was easily detached by the finger only, and which I imagined to be nothing but zinc, the particles of which were in part separated, it was reduced to the weight of 13,380 grammes.

2. The portion of the new metallic alloy of zinc and lead*, produced by the decomposition of the acetite, was washed several times with distilled water. Being submitted to the action of a good press, and afterwards to a gradual percussion on a piece of steel, it shewed a superior degree of ductility to lead alone. It was dried in close vessels, and put into an iron ladle over a brisk fire; part of it was quickly converted into greenish yellow oxyd The other portion being melted without addition, I obtained a small metallic globule, weighing 9,0183 grammes, containing zinc; but in much smaller quantity, in proportion to the weight, than the substance previous to its being melted.

* The formation of this metallic alloy agrees with the experiments of M. Vauquelin; whence it results, that when a metal is precipitated from its solution by another, the metal precipitated carries with it a small portion of the precipitant. This phenomenon takes place particularly in the precipitation of white metals by zinc.

I must

I must observe that, notwithstanding the pains I took to separate all the water lodged between the particles of the metal, both by means of pressure with unsized paper, and by desiccation, I found it impossible to effect my purpose. From this circumstance it seems probable, that the speedy oxydation of the new metallic alloy was owing, 1, to the decomposition of the particles of water that could not be entirely expelled; 2, to the presence of the atmospheric air of the vessels; 3, lastly, to the contact and decomposition of the same fluid during the fusion of the metal.

Examination of the Liquor with various Re-agents.

1. The liquor poured off from the decanter was colourless, and perfectly transparent.

2. It turned blue vegetable colours to a dark green.

3. Being tried with very pure sulphuric acid, it formed no precipitate, which convinced me that it held no more lead in solution.

4. A portion of it being evaporated, produced small crystals of acetite of zinc, arranged in no particular form.

5. Ammoniac produced in it a white, flaky precipitate, but in very small quantity. At the moment of contact it emitted a very strong smell of flour-paste, which was quickly dissipated by agitation.

6. This precipitate acquired, in a few hours, a demi-gelatinous consistence; and the addition of a fresh quantity of alkali again dissolved it partially.

7. Carbonates of pot-ash, soda, and ammoniac, formed white precipitates more or less abundant.

8. Lime-water recently prepared precipitated the zinc, in the state of oxyd, of a clearer white than the former.

9. The

9. The precipitate obtained with carbonate of pot-ash, washed several times with distilled water, was of the most exquisite white colour, and extremely light.

10. When brought in contact with concentrated sulphuric acid, it is completely dissolved in it, and carbonic acid is disengaged. The sulphuric acid entirely loses its smell, which seems to indicate a very great similarity between the new salt resulting from this combination and the sulphate of zinc, for the discovery of which we are indebted to Messrs. Vauquelin and Fourcroy.

Conclusions.

From the above facts it results; 1. That the decomposition of acetite of lead by zinc is accompanied by various phenomena, not observed in that of other salts and metallic solutions by the same metal.

2. That distilled water appears the more favourable to this decomposition, as it is effected in that liquid in a third less time than in common water.

3. That, nevertheless, common water appears preferable for experiments of mere curiosity, as it retards the decomposing action of the zinc, and disposes the metallic particles to the arrangement which is best suited to them, a phenomenon which accords with the laws of crystallization.

I shall conclude these observations by proposing to the College of Pharmacy to adopt, amongst the experiments forming part of the public lessons on chemistry given annually, that of the tree of Saturn, as calculated to demonstrate clearly the powerful attraction of zinc for oxygen. This experiment, attended with a trifling expence, invariably succeeds, and may find a place in a cabinet of mineralogy by the side of the tree of Diana.

Transactions of Societies for promoting useful Knowledge.

London.

Society of Arts.

THE Society for the Encouragement of Arts, Manufactures, and Commerce, has proposed the following premiums, in addition to those offered last year.

To the person who shall invent, and produce to the Society, the most effectual, mechanical, or other means, for cleansing chimnies from soot, and obviating the necessity of children being employed within the flues, the gold medal.

For the next in merit, the silver medal.—The mechanical or other means, with certificates of their having been used with proper effect, to be produced to the Society on or before the first Tuesday in May 1803.

The same premiums are extended one year farther.

To the person who shall during the year 1803 cleanse, or cause to be cleansed, the greatest number of chimnies, at least two stories high, not fewer than 300, by a mechanical or other process, which does not require the employment of boys within the flues, the gold medal.

Certificates, signed by not less than two-thirds of those housekeepers on whose premises the said means have been employed, and an account of the process, to be produced to the Society, on or before the first Tuesday in February 1804.

To the person who shall cleanse, or cause to be cleansed, the next greatest number of chimnies, not fewer than 150, on similar conditions to the above, the silver medal.

The Society has also just published its annual volume, containing, as usual, a variety of communications in agriculture, chemistry, mechanics, manufactures, &c.

FRANCE

FRANCE.

National Institute.

The following subjects have engaged the attention of the class of mathematical and physical sciences, from October to December, 1802.

Observations on the Transit of Mercury over the Sun's Disk, the 9th of November, 1802.

The first of these phenomena, recorded in the Annals of Astronomy, was observed in 1637, at the College of France, by Gassendi. Since that time the greatest attention has been bestowed on observations of these transits, which occur very frequently. M. Lalande has undertaken to collect them in one view, and to discuss them with a patience and accuracy for which he has been compensated by the perfection which his Tables of Mercury have acquired from this labour. After having corrected successively every result, he waited for their confirmation from the transit announced for the 9th of November; and he hoped then to convince himself, that these tables, one of the most important productions of his persevering industry, possessed the utmost degree of perfection to which they could be brought in the present state of the science. His wishes were completely accomplished, according to the result of his observations, and those of the principal astronomers of Paris.

M. Messier also presented to the class a particular account of his observation of the transit of Mercury, during which he determined successively 25 positions of that planet, by comparing it either with the circumference of the sun, or with a spot of considerable magnitude which appeared on that luminary, the diameter of which was 25″ of a degree.

 M. Mes-

M. Messier's memoir contains a detailed table of the determinations which he obtained, and is accompanied with a drawing, representing the apparent route of Mercury over the sun. A luminous ring is seen in it, with which Mercury appeared to be surrounded. This circumstance, observed only by M. Messier, was remarked by him in the transit of 1799. The same had been observed in 1736 at Montpellier, by Plantade; and in 1786, at Upsal, by M. Prosperin. This ring shed a very feeble light, very different in colour from the sun's. Its diamemeter towards the conclusion of the transit was 1′ 19″, and Mercury's 17″.

On the best Method of making magnetic Needles.

After having compared the various processes proposed by Duhamel, Knight, and Æpinus, to give a needle the utmost directing power it is susceptible of, M. Coulomb has decided in favour of that of Æpinus. He has ascertained, that it is preferable to make needles long and broad, but not thick. Mr. Jeckel has opened a shop for the immediate application of these important results to the use of the marine.

On various Inventions relative to the Art of Coining.

France has, within these few years, made remarkable improvements in this art; but which have hitherto been confined to those persons who practised them. In presenting to the class the collection of ingenious machines, invented by him, M. Droz has given occasion to Messrs. Desmarets, Périer, Charles, Berthoud, and Prony, the persons commissioned to examine them, to collect whatever has been written on the formation of dies; so that this report is a complete treatise on coining, or a history of the processes, preceded by their description. The class therefore ordered it to be printed.

On

On the Crop of Wheat obtained last Year in the Park of Rambouillet.

In the comparison which M. Tessier has made between the crops of wheat at Rambouillet in the years 1801 and 1802, after explaining the qualities of highly abundant crops, and which are rarely found combined, he demonstrates that, when one or more of these qualities are wanting, others are improved in such proportion as to compensate for their deficiency. He observed at the last harvest, at the rural establishment at Rambouillet, that 100 sheaves yielded 424 litres of grain, whereas the preceding year a similar number of sheaves furnished 338 litres of grain; that is, one fifth less. Three hectolitres of the former weighed 246 kilogrammes, and three hectolitres of the latter 232, the difference in weight being 14 kilogrammes.

Proceeding with this examination, M. Tessier discocovered that the grain of the last harvest produced more flour than that of the preceding. He states their respective weights, as well as that of the bread obtained from equal quantities of the two kinds of flour. The harvest of 1801 had the advantage over that of 1802, in this respect in proportion to its quantity.

On the Sale of Wool from the National Flock at Perpignan.

The improvement of wool, begun and prosecuted with so much zeal by the venerable Daubenton, is continued in such a manner as very soon to produce the happiest results. The establishment for sheep near Perpignan, intended for the propagation of merinos in the South of France, has this year put up for sale a certain number of those animals.

In announcing this intelligence to the class, M. Tessier gave an account of the amount of all the fleeces of that

flock. The vicinity of Spain, which facilitates the importation of superfine wool immediately from thence, rather injured the sale at Perpignan, the price being lower than at Rambouillet. This difference, although at present inconsiderable, would be still farther diminished if manufacturers would follow the example given by Messrs. Peyre and Co. of Marvejols, who manufactured cloth with the wool of the flock at Perpignan; for which they obtained a medal at the public exhibition of the productions of French industry. It was this house which purchased the greatest part of the wool of the last shearing.

On steeping Hemp.

When intelligent men, accustomed to combine practice with theory, and to classify their observations, direct their attention to the processes of the inferior manufactures, the discordance of these processes soon convinces them that superfluous operations are introduced; and which a deeper investigation frequently proves to be prejudicial. The comparison of the various means employed for soaking hemp led M. Nicolas, professor of the central school of the department of Calvados to similar consequences.

The intention of soaking is to separate the different constituent parts of the vegetable, to extract from it the long filaments for which it is cultivated. Some, for this purpose, merely expose the flax or hemp for some time, to the air; others plunge it in stagnant water, or into rivulets; and the process is changed according to local circumstances. The author concludes, from this want of uniformity in one of the most simple operations, that its theory is not yet perfectly known.

He conceives that soaking is only the first step towards putrid fermentation. That which takes place in pools of

stagnant

stagnant water occasions a disengagement of ammoniacal gas, carbonic acid, hydrogen, and sulphureted hydrogen, from which result more or less dangerous fevers. Putrid fermentation, carried to too great a degree, injures the substance of the thread, and causes a considerable loss. Water in which hemp and flax has been steeped is considered insalubrious both for men and beasts that drink of it, and for fishes that live in it. Besides, to hemp when taken out of this water a portion of gluten is attached, which is separated by the labour of the hackler; and this gluten, when reduced to dust, very dangerously affects the lungs of the unfortunate workman.

M. Nicolas, persuaded that the destruction of the gluten results from its combination with oxygen, proposes simply to expose hemp to the open air instead of soaking. The dew, by its decomposition, gives up its oxygen, which attaching itself to the gluten, destroys its tenacity. He is likewise led to think that the carbonic acid contained in the dew contributes to its decomposition, and to produce the effect of steeping.

M. Nicolas directs water to be kept continually in evaporation in the hackler's workshop; and he likewise recommends the workman to cover his face with a piece of muslin, to prevent the ill effects of the cotton-like down, which is always disengaged from the hemp, however well it may be separated from its gluten.

M. Nicolas concludes his memoir by advising, that hemp or flax, in a state ready for spinning, should, like linen for bleaching, be passed through a ley composed of 4 ounces of common oil and 2 lbs. of pot-ash to 50 pints of water. This mixture, which should be several times heated, is sufficient for 100lbs. of hemp.

Intelligence relating to Arts, Manufactures, &c.

Composition for preventing Fires.

PROFESSOR Palmer, of Wolfenbuttel, has invented a composition to prevent combustible substances from taking fire. It consists of a powder, composed of one ounce of sulphur, one ounce of red ochre, and 6 ounces of copperas. To prevent wood from taking fire, it is first covered with joiner's glue, over which the powder is spread. This process is repeated three or four times after the wood has become dry. For linen and paper only water is used, instead of glue, and the process is repeated twice. If this powder be thrown on substances actually in combustion, two ounces of it will extinguish fire to the extent of a square foot. The first experiments of the application of this discovery were made on the 11th of December, and gave general satisfaction.

New optical Instrument.

An instrument by means of which substances may be discovered and sought at the bottom of the sea, has been invented by Mr. Gabriel Collin, optical instrument maker to the Academy of Sciences at Stockholm. From some experiments made by order of the King of Sweden it appears, that by means of this instrument bright objects may be seen at a depth of 53 feet, and opaque bodies at 27 feet. There is a contrivance in it which enables the observer to look as deeply into the water in misty or foul as in fair clear weather. The wind never hinders its use, for which only one person is required. His Swedish Majesty has rewarded the artist with a gratuity of 100*l.* and the Academy of Sciences is drawing up a report on it.

Method

Method of augmenting the Force of Gunpowder.

Dr. Baini, a physician of Fojano in Tuscany, has discovered, that by the addition of three ounces of pulverized quick-lime to one pound of gun-powder its force is augmented one-third. No farther preparation is required than to shake the whole together till the white colour of the lime totally disappears. Various trials have been made with it which confirm its superiority over the common sort.

French Woollen Manufactures.

The French government has granted a patent for 15 years to the inventors of several machines very important to the manufacture of woollen cloth. They are 12 in number, and great hopes are entertained in that country that they will tend to lessen the expense in the manufacture of that article, and to increase the general commerce of the republic.

Premiums for Manufactures, &c.

The trustees for promoting the hempen and linen manufactures of Ireland have offered various premiums for breaking, scutching, hackling, and spinning hemp. Amongst others are the following:

To the owner of any mill wherein shall be broken or scutched the greatest quantity of sound hemp, of Irish growth, between 1st June, 1803, and 1st June, 1804, not less than 100 tons, the sum of 300*l.* For the next greatest quantity, not less than 80 tons, 100*l.*

The sum of 4,138*l.* is appropriated for premiums for machinery for spinning hemp or flax, of Irish growth, for sail-cloth, before the 1st of January, 1804: to be divided according to the number of spindles employed; if such mill contains 1000 spindles, or more, the sum of 25*s.* for each

each spindle; if 500, but not 1000, the sum of 20s. for each; if 200, but not 500, the sum of 17s. 6d. for each; and if under 200, the sum of 10s. for each.

For the best constructed, and most efficacious, machine for breaking hemp better than any hitherto in use in Ireland, the sum of 100*l.*

List of Patents for Inventions, &c.

(Continued from Page 160.)

ROBERT WILSON of the parish of St. Saviour, Southwark, Surrey, Plasterer; for an apparatus for the purpose of stopping ungovernable horses.
Dated January 20, 1803.

JOSEPH JACOB, of Greek-street, of the parish of St. Ann, Soho, Middlesex, Coachmaker; for a metal box for the axle-trees of wheels, carriages, mills, engines, and other machines. Dated January 20, 1803.

GEORGE MATCHAM, of the city of Bath, Esquire; for a principle or mechanical power for raising great weights, in preventing ships from sinking, in raising ships when sunk, in rendering ships which are disproportioned to shallow-water capable of entering rivers, passing bars, or shoals, or otherwise moving in shallow water; and for a variety of other useful purposes.
Dated January 29, 1803.

EDWARD STEPHENS, of the city of Dublin, for a furnace, stove, or fire-place, which can conveniently be applied to the burning of lime-stone, at the same time that it is used for the heating of all manner of corn-kilns, evaporating-stoves, and drying-houses.
Dated January 29, 1803.

THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

NUMBER XI. SECOND SERIES. APRIL 1, 1803.

Specification of the Patent granted to MICHAEL BILLINGSLEY, *of Birkenshaw, (now of Bowling Iron-Works, near Bradford, in the County of York,) Engineer; for an Instrument, Engine, or Machine, to be worked by Steam, Water, or Horses, &c. for the Purpose of boring Cylinders of Iron and Brass, for Steam-Engines, Air-Pumps, and other Machines, whereby such Cylinders are bored more true, smoother and with greater Facility, than by the Methods hitherto employed for the same Purpose.* Dated December 22, 1802.

With a Plate.

TO all to whom these presents shall come, &c. NOW KNOW YE, that I the said Michael Billingsley do hereby declare the nature of my said invention, and the manner in which the same is to be performed, as hereinafter particularly described, as follows; that is to say: My instrument, engine or machine, consists of certain parts

parts or apparatus, organized and connected together, in such a manner that the cylinder intended to be bored shall preserve a vertical position as to the axis thereof, instead of the horizontal position heretofore adopted and used; by which means I permit the sand and borings from the face of the metal to fall down, instead of occupying one side of the cylinder, and wearing away the edges of the cutters, so as to require them frequently to be changed, and to cause an irregularity in the figure, and even in the diameter of the cylinder, thereby rendering the same much less effectual for steam-engines, or any other piston work, in which it is essential the fittings should be very accurate. Whereas, in my new method, the finishing part of the cutters are employed upon a clean face of metal, and not being encumbered with the cuttings, the cutters go completely through from first to last without requiring to be changed, and bore the cylinder with the utmost precision and truth.

The drawing hereunto annexed, (see Plate XIII.) represents a section of the said instrument, engine, or machine, in which A A, Fig. 1, represents a round pit, walled with stone or brick about four feet deep, with cast-iron pillars, firmly built and bedded in the masonry thereof, for the purpose of screwing down a cast-iron ring on a level with the mill-floor. B B is a strong iron plate fixed in the building of the pit, and serving to afford a proper support for the gudgeons of the horizontal wheels. K K represent two mitre gear wheels, communicating motion from the first mover. D is a wheel upon the same arbor as K, and serving to drive another horizontal wheel C, into which last wheel the boring rod G G is inserted, and by which the said boring rod is carried round. F F represents an horizontal, strong, metallic piece, formed of eight radii or arms, [*in which are grooves, open to*

to the upper surface *,] proceeding from the centre, where the brasses or collar-work of the boring-rod are lodged. This horizontal frame is very firmly screwed to the iron bolts in the masonry. It serves to support the standards H, H, which can be slided (in grooves, represented by the dotted lines) to different distances from the centre, and there fixed, [*by screws with* T *heads, adapted to the grooves*,] so as to retain the cylinder by means of the clamps I, I. JJ, represents the cylinder fixed below by the clamps I, and above by screws *q*, proceeding from a strong metallic ring, represented at P P, [*which ring is made to slide along the inner limb of the uprights* L, L]. L, L, are two very strong uprights of cast-iron, screwed to the bottom ring F, and supporting the cross beam S, S, which affords the upper collar and brasses for the boring-rod G. [*The inner limbs of these uprights are perforated, for the purpose of fixing the sliding-ring* P P *at any elevation*.] M M, is the boring head, carrying the cutters as fixed in the sliding-collar N. O, O, two racks, which carry the boring-head down the cylinder. R R, is a strap embracing the boring-rod and wheel T, which last is by that means carried round. The train of wheel-work U, V, W, X, in the usual manner of tooth and pinion work, produce a slow motion in the arbor Y, which, by means of the pinions Z, Z, cause the racks O, O, to work the boring-head downwards.

From the foregoing description of the machinery, every competent workman or engineer will easily understand the process or mode of operation; for which reason it is unnecessary to enter into any farther detail. I therefore

* The parts printed in Italics between crotchets are not inserted in the specification, but are here introduced at the request of the patentee.

 shall

shall only observe, that the communication from the first mover to the boring-rod G, may be varied as to the number and figure of the wheels [*necessary to produce the various degrees of speed requisite to bore different sized cylinders, it being obvious such combination will in a great measure depend upon the nature and velocity of the first moving power*]; and also that the slow motion of Y may be effected by other trains of wheel-work, or by a screw, or by various other well known methods, which skilful workmen will find no difficulty in applying to the instrument, engine, or machine, here described. In witness whereof, &c.

The following observations accompanied the preceding Specification, in a letter from the Patentee.

Bowling Iron-Works, near Bradford, March 4, 1803.

GENTLEMEN,

The steam-engine having become of the highest importance to the manufacturing interests of these kingdoms, any invention that has a tendency to the improvement and perfection of that most useful machine will, I doubt not, meet with approbation and encouragement. Hence I am in hopes it will not be unacceptable to the readers of your very valuable publication to be presented with information respecting a few of the improvements or advantages possessed by my vertical method of boring with the engine or machine of which the preceding plan and specification are descriptive, over the horizontal mode

mode hitherto made use of; and such information I am enabled to give, from very ample experience and proof, the machine having been erected a considerable time, and repeatedly applied to cylinders, pumps, &c. of various dimensions, all which have thereby been bored with much superior accuracy and expedition.

It is well known that a hollow metallic cylinder, when laid in a horizontal position, has, from the pressure of its upper parts, a tendency to assume the elliptical or oval form; *i. e*, the horizontal diameter of that cylinder will be greater than its vertical diameter; and this, in a greater or less degree, in proportion to the size and strength of the cylinder: such departure from a true cylindric figure is rendered still more considerable by being strongly chained or bound down to the frame or carriage on which cylinders have heretofore been bored. This source of inaccuracy, (formerly unavoidable in slender and large cylinders,) so much and so justly complained of, is totally done away by my new mode of boring. The cylinder itself standing vertically with respect to its axis has no tendency to change its figure, and the screws, clamps, &c. made use of to fix the same immoveably in its position, proceeding from the arms in the upper and lower metallic rings of the machine, embrace the flanches, or other parts of the cylinder most capable of resistance, in so many points, and on all sides so equally, that not the least deviation from a true circle is discoverable in the bore thereof. The importance of this most essential property in steam-cylinders, pumps, &c. I think needs no elucidation. The destruction of steam, loss of power, and frequent renewal of expensive packages attendant upon an untrue cylinder, working-barrel, &c. are too well known by every practical engineer, and too severely

severely felt by every intelligent proprietor of such an engine, to require any particular exposition.

Besides the great superiority in the precision of boring above mentioned, and the evident advantages recited in the specification of boring through without any change or alteration in the cutters, and thereby producing a more uniformly exact and smooth bore, than can possibly be obtained in the horizontal mode, the comparison relative to the time and attendance requisite in each method to the performance of the same work will I trust be deemed worthy some attention. From the experience I have had in both methods of boring, I am fully enabled to state, that of the time necessary to fix and bore a cylinder, after the horizontal mode, at least three-fourths may be saved by the adoption of my method in cylinders of moderate dimensions, but those of large diameters I can fix and bore completely in one-fifth or one-sixth of the time usually required to do the same in the way hitherto followed. From an inspection of the machine, it will also appear, that by having a knowledge of the speed of the sliding head and the cutters, and also of the train of wheel-work impelling the same vertically down the cylinder, the precise time of boring any article may be exactly known, and will always, in the same gear, be proportional to the length of that article. Hence no attendance will be necessary from the first setting to work to the completion of the same; nor even then will the neglect of a few hours be productive of the least injury to the work. But, in the common mode of boring, attendance must be constantly given by one, if not by two persons, either to press forward the cutters by hand and lever, or frequently to change the position of the levers in the axis of the pinions, and to raise the weights, &c.;

and

and should any neglect occur in the finishing course, the cylinder at least mustbe bored again if it be not irreparably injured.

The central rack with the pinion and drum *a*, *b*, and *c*, not described in the specification, and the wheel and pinion *d e* connected therewith, is a sketch of the method I employ to lift or raise the boring-rod, head, &c. out of the cylinder when bored and ready to be removed away, or to change the boring head and cutters. This, or any other contrivance to effect the same, may be adopted as may best suit local circumstances.

I am, Gentlemen, &c.

To the Proprietors of the Repertory of Arts, &c.

MICHAEL BILLLINGSLEY.

P. S. I beg leave to add, that I have removed from Birkenshaw to Bowling Iron-works, near Bradford, Yorkshire, and have made an assignment of one moiety of my patent-right to John Sturges, Esq. one of the proprietors of those works, who is now erecting an extensive mill upon the patent principle, and who will be happy to treat upon liberal terms with any reputable engineer, or proprietor of a boring mill, desirous of adopting my improvements.

Specification

Specification of the Patent granted to THOMAS RICHARDSON, *of Iron Acton, in the County of Gloucester, Tanner; for Improvements in the Arts of preparing, colouring, and joining, or uniting, the Skins of Sheep and Lambs.*

Dated June 26, 1802.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Thomas Richardson, do hereby declare that my said invention is described in manner following; that is to say: After the said skins have been tanned in the usual manner with oak-bark, shumach, minerals, or other substances, fit and proper for that purpose, or otherwise treated, for the purpose of converting the same into a permanent and durable substance, whether known by the name of leather, or by any other denomination, the said skins are taken from the vats, and prepared by beating the same on the wool side, to discharge the loose pieces of bark and other impurities; after which they are well washed in a running stream, and left to soak in clear water till the next day, and then the beating and washing are to be repeated, and the skins again left to soak; and in this manner they are to be treated until the smell is dissipated and the wool appears of a clear good colour, which will generally take place in the course of six or eight days. The skins are then to be scoured in the usual manner, with a strong ley of wood and pearl ashes, or soap, and left to drain on the horse, when they must be carefully examined; and those which are intended to be dried of the plain colour the wool takes from the tan vats, are to be hung on the hooks for that purpose; but those intended for fox or tan colour are prepared by plunging

plunging and keeping them (with occasional agitation) in strong clear lime water, until the colour is as deep as required. The lime-water is prepared as usual, by slaking a few pieces of good quick-lime in water, and stirring the mixture, which is then suffered to subside, and the clear part decanted off. I must also remark, that the last-mentioned colour may be obtained in many other ways with lime and water, but that, after many trials, the method here described was found to be the simplest and most effectual. When the skins are perfectly dry they are in a fit state for colouring, of a variety of fancy colours, in imitation of animals, or in any other manner, as follows. First, the skins intended to be joined must be carefully matched, as well with regard to the length as the colour and thickness of the wool, and marked. The whole is then to be beaten and carded, to make it as clean as possible, and taken to the dye-house. If the skins be intended to be spotted or figured, whether on the original coloured ground, or upon any other colour or tinge which may have been communicated to the wool, a board, or other similar contrivance, must be prepared, of the length and breadth of the skin, and perforated with a variety of openings, according to the fancy of the manufacturer; and the skin is to be spread upon the said board, and the wool drawn through the holes, by means of small hooks, or other well-known implements, so as to fill the said holes. The board supporting the skin in this situation is then to be suspended horizontally to a pulley, so as to be drawn up or let down at pleasure. When the intended colouring stuff is ready, the board is to be gently let down, and suffered to float upon the liquor, and then drawn up and aired, and again let down till the colour is sufficiently fixed; and, during this process, care must

 be

be taken not to let the hot liquor touch the leather, as it would infallibly spoil the skin. If the spotting or figuring is required to be reversed, that is to say, the spots preserved of the natural colour, or first colour of the ground, while the ground itself shall be made to take another dye; a plain board must be prepared, and the form the intended spots, figures, &c. being cut in wood, cork, leather, or any other proper substance, and nailed upon the face of the skin to the board itself, agreeably to the intended pattern. The board is to be suspended as before; but in this case, as the skin is attached to the under side of the board, this last must not be suffered to float, because the skin would by such treatment be brought into contact with the hot dye, but the descent must be managed with great care, so as to produce the intended effect without damage. When the skins are thus dyed, tinged, or spotted, of all colours and forms, they are to be well washed, and hung up to dry. When the skins are dry, they are dressed by well beating on the wool side to hollow and raise it; after which the skin is to be fixed on the edge of a board, of a proper size, and the wool combed throughout with a large coarse comb, and smoothed with a pair of hand-cards, and the edges neatly cut. Those skins which are intended to be joined or united must be carefully matched as to colour, length, and thickness, of wool, and placed on a table with the leather side upwards, the edges of the skins brought together, and sewed with strong waxed thread, a little below the edge, which is then to be turned over, and rubbed down close. This method answers two purposes; the seam is concealed, and the stitches are prevented from wearing. The last-mentioned effect may be produced in various other ways, such as by leather pasted and sewed

in

in stripes over the seams, but I have found the above to be the most simple, and to answer the purpose best. After the said skins have been prepared by the use of oak or other barks, shumach, minerals, or other fit substance, or tawed with allum, salt, or other materials, or treated in any of the customary methods used or known for the purpose of fixing the wool or hair upon the same, and preventing them from putrefying or decaying, and after the same have been coloured, dressed, and joined, as aforesaid, I manufacture the following articles as the products of this my said invention.

First, I simply join or unite the skins of the dimensions required for common carriage-rugs, hearth-rugs, mats for doors, bed-sides, mattrasses, coachmen's-aprons, water-proof mats for covering trunks, &c. hammer-cloths, and a variety of other articles, either of the plain, natural colour, or of any fancy colour, &c.

Secondly, I make rugs, and other pieces, with pockets or muffs for the feet, by folding or turning the wool side of the skin in the form of a pocket or basket, securing it by means of buckles and straps, and facing the folded part with prepared leather, or part of the same skin, &c. This article may be used at pleasure, either folded or open.

Thirdly, I make rugs or carpets for carriages, joinea with two or more skins, to the size intended, with the pockets or baskets for feet, and lined on the leather side with prepared leather, stitched or quilted down, secured with buckles and straps, and intended to be used for a summer mat as well as for winter, by turning the leather side upwards in warm weather, and the wool side, with the pockets buckled up, in cold.

Fourthly, I make rugs or carpets for doors, carriages, and hearths, of a single skin, plain or coloured.

Fifthly, I substitute my said pieces for door mats, to fit the door cases, by joining and cutting to fit and strengthen the corners.

Sixthly, I construct feet-baskets, or receptacles, by folding a skin to fit the feet, securing it by buckles and straps, which may be loosened at pleasure, and the piece used as a mat, wrapper, cushion, or for any purpose requiring warmth or protection.

Seventhly, I apply my invention for urn-rugs, table-mats, &c. cut to the desired form, and covered on the leather side with prepared leather, pasted down.

Eighthly, I use the same for boots and shoes, or other warm coverings for the feet, made open in the front, as far as the joints of the toes, to be fastened with strings, buttons, or laced, &c. to inclose the foot and shoe.

Ninthly, I make muffs with sheep skins, and line the same with lamb skins.

Tenthly, I make three sorts of shoe-socks, or soles, for the feet. First, of sheep's skin, stiffened on the leather side with glue, paste, &c. the wool and leather being cut to fit the shoe. Second, of sheep skin, stiffened and shaped as above, with prepared leather, paper, pasteboard, with a piece of painted canvas, thin wood, &c. to render them water-proof between the two leathers, or any other substance, pasted or glued, or sewed on the leather side. Third, of fine lamb-skin stiffened, the edges cut or uncut, prepared with leather, or other strengthening materials, as the second article, on the back, and stitched for security at the edges, &c.

In witness whereof, &c.

Specification of the Patent granted to JOHN SCOTT *and* JAMES CLARKSON, *of Lower-street, Islington, in the County of Middlesex, Brick-makers,* WILLIAM TATHAM, *of Staple's Inn Buildings, Holborn, in the said County of Middlesex, Esquire, and* SAMUEL MELLISH, *of Holborn-court, Grays Inn, in the said County of Middlesex, Gentleman; for certain Articles, denominated* Tatham's Clumps, *for the Purpose of constructing Water Pipes, Sewers, Tunnels, Wells, Conduits, Reservoirs, or other circular Walls, Shells, or Buildings, by various Modifications of the said Invention, by Means of divers Methods of Shoulderings, Securings, and Combinations of Earth, Stone, Plaster, Cements, Composition, Kiln-burnt Materials, &c. keyed together by Means of Wedges, Joints, Clumps, or other Fastenings, so that all the Pieces may be combined together in forming one strong and secure Utensil, Apparatus, or Contrivance, for constructing circular Walls, Columns, Rollers, and for attaining hydraulic Communications, or resisting the Application of any reasonable Force with Effect.*

Dated December 21, 1802.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, we the said John Scott and James Clarkson, William Tatham, and Samuel Mellish, do hereby declare that the invention claimed and set forth by us does and do consist in so shaping, forming, moulding, modelling, hewing, or cutting, the material intending to be formed into Tatham's clumps, to be used in constructing the building, utensil, or apparatus designed, that the sides or edges thereof, when made and completed, shall join and

and fit to each other on an exact radius of a circle, terminating at its centre; so that when all the said parts are put together with or without mortar or cement, the said several clumps will form a direct circle, bearing pressure inwards on the principle of an arch; and that when the several layers, courses, or distinct circles thereof shall be fitted and adjusted in their proper places, such will form what is termed a broken joint in the wall or shell, so that the same will alternately clamp or join the courses next adjacent to them together, to prevent their removal sideways. And farther, that being fitted to each other on their flat sides, alternate male and female (see drawing annexed), by means of the shoulderings or wedgewise-securings, and abutments, which will be better and more clearly understood by a view of the drawings annexed to these presents, and to which we hereafter particularly refer; the same will bear and resist a pressure outwards from any application of a reasonable force. And we do farther declare, that such and the foregoing is the principle or principles on which we claim and assert our patent-right to the same, admitting of various and easy modifications for the joining and connecting of branches, terminations, abutments, shoulderings, fastenings, girders, returns, or other modifications of the work, where it may be necessary to terminate or break the circle or segment thereof, or in any way to secure the same, by means of key-clumps, blank-sides, iron flanches, bolts, nuts, screws, or other securings. And farther we declare, that we have agreed to make known the same by the name or technical term of "Tatham's Clumps," in honour and respect to the said William Tatham, the principal inventor thereof. And moreover we do declare, that we hold and consider the same peculiarly superior for the formation of the following articles or

buildings,

buildings, (with or without fastenings or cements, according to the nature of the case,) if used and applied according to the principles exemplified by the drawings annexed, *viz.* water-pipes, sewers, tunnels, wells, conduits, cess-pools, culverts, cylinders for bridge-work, (thereby strengthening the structure, and relieving the water-way,) columns, pillars, colonnades, (either hollow or solid work,) steam-engine pits, capstan wells, arches, particularly reversed arches for the floors of pound-locks, water-ways, &c. in soft grounds; circular windows, or other apertures in warehouses, or other walls requiring strength, light, air, and security, conical or oval buildings, such as glass-houses, tile or lime kilns, ice-houses, &c. (where such will bear the expense of separate moulds,) staircases, (hereby capable of being formed into one detached piece of masonry entire, and secure from conflagration,) towers, turrets, summer-houses, and all other circular shells and buildings. And farther we declare, that it is practicable, and our intentention, to form and make the said clumps out of, or from any or all of the following materials, *viz.* earth, stone, clay, plaster, cements, composition, kiln-burnt materials, masonry, and of all other materials applicable to the construction of the aforesaid several buildings exemplified in the drawing hereof, or other circular buildings. And, lastly, we declare, that the said drawings are specifications of our principles, as applied to the cases exemplified, and as applicable to each and every case respectively, according to its particular modification. In witness whereof, &c.

Explanation of the Drawings.

Fig. 1, *a*, is a single clump, having its male point inwards on the side in view. *b*, ditto, with the female point inwards, on the reverse of the same clump.

Fig. 2, *a*, ditto, with the male point outwards. *b*, ditto, with the female point outwards. N. B. Each of these figures, 1 and 2, represent a separate kind of clump, which being laid, one kind at a time, in a circular form, with the same sides uppermost, will make one course: see Fig. 5, for an example of one course of clumps, Fig. 1, *a*. Then add one course of Fig. 2, fitted in male and female (or joggled), and so on, alternate circles, Fig. 1 and Fig. 2, to the end of the length designed; terminating the same with a cast-iron plate, flanch piece, or key clump, with two male sides, so as to admit of taking down for repairs, &c. This method will form a broken joint, such as the one exhibited in perspective view, Fig. 9.

Fig. 3, is an elongated clump, for forming solid colums, colonnades, *(a)* having its male point inwards, and *(b)* having its female point inwards.

Fig. 4, a clump elongated, as in Fig. 3. *a*, shews the view, with the male point outwards. *b*, the reverse of the same clump, with the female point outwards. N. B. These kind of clumps are an elongation of the clumps described in Figs. 1 and 2, and are to be laid into each other in the same manner, to form a column of solid work, as represented in Fig. 8, which shews the method of laying the elongated clump *a*, Fig. 4. If it be intended to construct a circular staircase, with the dome, light, &c. on this principle, one or more clumps in each course of work (be the same of brick, earth, stone, or other material, according to the design and extent)

extent) must be of the elongated kind, to form the step of the stairs; all the rest being short clumps, to admit light and access through the aperture, of a spiral ascent.

Fig. 5, shews the position of the clumps *a*, Fig. 1, according to the mode of laying them, with the male point inwards, as represented in the view. *b*, shews the reverse of the same clump, with the female point inward. The bottom circle in this and the next figure shew merely the position which a continuation of the clumps would take.

Fig. 6, shews three blank sides uppermost: these are merely for laying the first course on the ground, or (in some instances) for saving the expense of a cast-iron rim next the flanch of a branch piece. Their reverse must be always indented (or joggled) to fit the next course of clumps. If it be required to form a flush edge (such as the cheek of a window or door), it can be done by cutting down the clumps into half clumps, as represented by the dotted lines X, X, Fig. 9. Reveals, rabbets, grooves, &c. and returns of corners, elliptics, &c. may secure any variation by means of suitable cast-iron clamps, modified according to the particular contingency.

Fig. 7, shews the plan of a well or pipe, &c. the surface of the circle in view being put together with clumps, Fig. 2, the male side *(a)* pointing outwards.

Fig. 8, shews the plan of a solid column, formed of elongated clumps of the kind *(a)* Fig. 4, the male points outwards being in view. As this same modification contracts the circle to a smaller column, in that case fewer pieces will be required.

Fig. 9, is a perspective view, shewing a segment of the work (part of a circle), formed out of six clumps,

laid in their order from Figs. 1 and 2, the bottom course having a blank side, as described in Fig. 6.

Fig. 10, part of a clump mainpipe, shewing the method of flanching in a cast-iron branch piece, in order to join the same to a branch-main. This can be performed with the help of an iron rim (joggled), as represented in Fig. 11, or it can be fitted to blank sides next the flanch, and the opposite end of the bolt can be counter-sunk into perforated clumps.

Fig. 11, a cast-iron rim, indented (or joggled), to fit a course of clumps, as represented on the surface in view, in order to admit the flanch to slip in and out as required in its smooth surface.

Fig. 12, a plain cast-iron flanch, for joining a clump-main in suitable lengths, to be occasionally taken down. They may also be laid in lengths, by means of a key clump, having two male sides, to have the joint banded with an iron hoop.

N. B. Rollers for gardens, or for agricultural purposes, &c. are to be made in the manner of the solid work, Fig. 8, fixing an iron gudgeon in the centre of the work, and flanching a cast-iron rim on each end.

N. B. In fitting the flanch of the joint or branch pipe, the end of the bolt-iron must be cut off, even with the inner flanch plate or blank-sided clump, and a female screw must be made in that end of the bolt, to receive one end of a prominent point, the flanching-nut being screwed on the other. By this means the smooth surfaces of the flanch plates will admit the joints to be slipt in or out of their birth at option, as in Fig. 13.

Specification

Specification of the Patent granted to JOHN VANCOUVER, *of Tachbrook-House, in the County of Warwick, Esquire; for an Earth of peculiar Properties, which, by certain new Processes of Manufacture, is capable of being rendered a Substitute for Soap.*

Dated July 23, 1802.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said John Vancouver do hereby declare, that the nature of my said invention, and the manner in which the same is to be performed, are herein after particularly described and ascertained as follows; that is to say: in the first place, I do proceed to describe the circumstances relating to the said earth of peculiar properties, by means of which the said earth may hereafter be distinguished and known. And in the next place, I proceed to describe the manufacturing processes by which the general properties, particularly the firmness and cohesion of the said earth, are improved, so as to render the same a valuable substitute for soap, in the various uses of the arts and of domestic life. The said earth is found in the parish of Tachbrook, near Warwick, on an estate belonging to the Right Honourable the Earl of Warwick, at the depth of from four to ten feet below the surface of the earth. It is not distinguished by any particular name, and is disposed or situated in the ground in three different strata or layers. The first or uppermost layer is of a greenish, or greyish colour; and the second layer is of a beautiful lilac, or light purple colour; and the third, or undermost, is generally white, although sometimes the white is found intermixed with the purple. The stratum upon which the said earth lies, is an indu-

rated

rated red marl, and it is superinduced by a bed of gravel. The thickness of the entire stratum of the said earth is from four inches to one foot; and its general position is very even, regular, and level. When first taken out of the earth its colours are very fine, particularly the lilac, which on exposure to the sun's rays, or to the influence of frost, soon becomes white. It has considerable weight, part of which it loses by drying, but in the manufacturing state its weight is very nearly that of the crude earth. Very little symmetry appears in its form or fracture. Its texture is very fine, with scarcely any exhibition of sandy or silicious matter, when pressed between the teeth. The chemical examination to which it has hitherto been subjected, has shewn that it contains clay, siliceous sand, and the oxide of iron; but a more studied examination would no doubt shew the existence of certain peculiarities in its component parts, or in the order of their combination, or the minuteness of its integrant parts, from which the detergent property of this earth might be found to arise. The processes for manufacturing the said earth are performed as follow. After digging it out of the vein, it is dried by means of stoves, or otherwise; then pulverized and sifted through fine sieves, or such other apparatus as is commonly used for sifting meal or other powders. A size is then prepared (in preference) from the white shreds of leather, and the dry sifted earth is beaten up or pounded or kneaded together with the said size, either by hand or by rammers, rollers, or such other machines or apparatus as are commonly used for the like purposes; after which operation it is formed into convenient parcels or cakes resembling those of soap, and of such sizes, figures, and dimensions, as are best adapted to the purposes of its intended application. The use of the size is to keep the

the parts of the earth together, and to moderate the effect of its absorbent quality, which is so extreme, as to cause it to become pulverulent like quick lime when water is added to the dried earth; and accordingly I do not confine myself in the said manufacturing processes to the use of size made of leather, but I do apply other animal and vegetable mucilages to the same purpose, giving the preference to such, as by their cheapness and adhesive quality are best adapted to the purposes of the manufacture: and I consider the present instruction with regard to the use of one of the said mucilages as sufficient to enable any person to execute any processes in that respect. Lastly, I do observe that the leading and most distinctive property of the said earth, is that of cleansing wool in a manner much superior to soap; because, it makes it equally white and clean, without robbing it of what manufacturers call its nature, as soap does. To explain these effects I must state the well-known fact, that when wool is washed with coarse soap, it undergoes some change, either in the polish of its surface, or in the elasticity of its fibres, or in some other respects, which cause it to feel less full in the hand, so that it will not rise and spring up after pressure in the same manner as it did before such washing. Whereas, on the contrary, wool, when treated with the washing earth, becomes equally white and clean, at the same time that it remains in possession of all its original fulness and elasticity, which are of great consequence and value in the manufacture of this important article of national produce.

In witness whereof, &c.

Description

Description of an Instrument for breaking up Logs of Wood for the Purposes of Fuel, by blasting them with Gunpowder. By Mr. RICHARD KNIGHT, *Ironmonger, Foster Lane, Cheapside.*

With a Plate.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

The Silver Medal was presented to Mr. KNIGHT *for this Invention.*

I HAVE frequently observed the great difficulty, labour, and loss of time, experienced in breaking up logs of wood, particularly for the purpose of fuel; such as the stumps and roots of large trees, which remain after the felling of timber, many of which, especially such as consist of the harder and more knotty kind, as oaks, elms, yews, &c. are frequently left to rot in the ground, in order to avoid the necessary expense of breaking them to pieces in the common way, which is generally effected by the axe, and driving a succession of iron wedges with a sledge hammer; a laborious and tedious process. Sometimes gunpowder is used, by setting a blast in a similar way to that in mines or stone-quarries. This method, though less laborious than the former, is tedious, is attended with several difficulties, and requires considerable experience and dexterity, or the plug will be more frequently blown out than the block rent by the explosion. With a view, therefore, to obviate these difficulties, I have constructed an instrument. The simplicity of its construction and application is such as almost to preclude an idea of its originality; but as it has hitherto appeared entirely

Pl. XIV. Vol. 2 second scene.

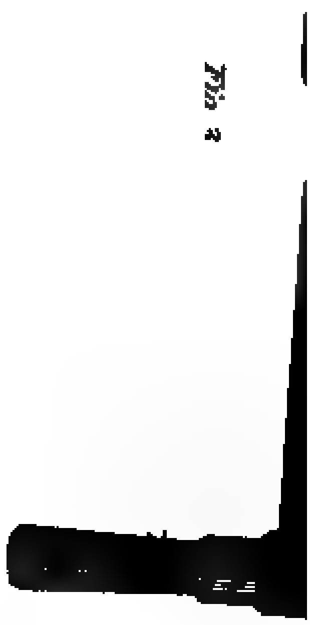

Fig. 2

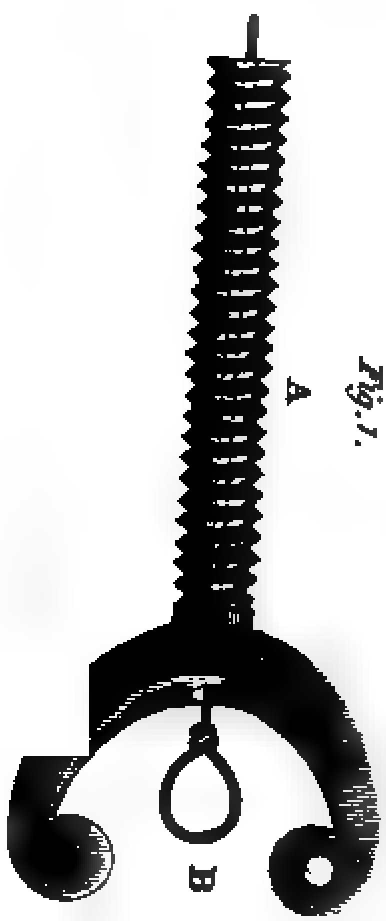

Fig. 1.

entirely new to all my acquaintance, and as I do not know that any thing of the kind has ever before been presented to the public, I am induced to think it may not be unacceptable.

Description of the Instrument.

See Plate XIV.

The instrument consists simply of a screw A, Fig. 1, with a small hole drilled through its centre. The head of the screw is formed into two strong horns, for the more ready admission of the lever by which it is to be turned. B, represents a wire, for the purpose of occasionally clearing the touch-hole previous to the introduction of the quick-match.

Fig. 2, an auger proper to bore holes, to receive the charge of the screw.

Fig. 3, a gauge, to make an entrance for the auger.

Fig. 4, a lever, to wind the screw into the wood, with a leather thong C attached to it, in order to fasten it occasionally to the screw, to prevent its being lost, a circumstance which does not often occur; for in all my experiments, when the wood has been tolerably sound, I have always found the screw left fixed in one side of the divided mass.

A roll of twine is to be steeped in a solution of nitre, for the purpose of a quick-match, or train, to discharge the powder, by thrusting a piece thereof down the touch-hole after taking out the wire B.

When a block of wood is to be broken, a hole is to be bored with an auger, of a proper depth, and a charge of gunpowder introduced. The screw is to be turned into the hole till it nearly touches the powder; a quick-match is then to be put down the touch-hole till it reaches the charge.

charge. The piece of quick-match is about eighteen inches in length, which affords the operator an opportunity of retiring, after lighting it, to a place of safety.

The first that was made was for J. Lloyd, Esq. of St. Asaph, the late member for Flint, who, having a great quantity of timber on his estate, considers it as a great acquisition; and at Overton Hall, last summer, spoke so favourably of it, in my presence, to Sir Joseph Banks, that he immediately sent for his smith, and requested I would give him the necessary instructions for making one; but as I left that part of Derbyshire soon after, I had not an opportunity of seeing it finished. Since my return home I have had several made, better finished, and with sharper threads, than smiths in general have an opportunity of giving them.

Letter from Mr. Lloyd.

Dear Sir,

After you left us last autumn, at Sir Joseph Banks's, his smith, who is a remarkably good workman, bestowed much needless time and trouble in making a blasting-screw; for he finished it in the highest style of polish, and, I think, made the thread of the worm too fine, or at least finer than was needful. However, it answered most completely, and very much to Sir Joseph's satisfaction, who lamented he had not seen such a contrivance many years ago, when a relation of his used to amuse himself with splitting the roots of trees, &c. in the common way. I have used the *blasting-screw*, for so I shall call it, all the last and preceding winter with the greatest success, and have gained many loads of fuel, which otherwise would have been suffered to rot, as the expense and labour in clearing the roots in the ordinary way renders the fuel

fuel so procured too expensive; and since I have had the screw, I have observed some hundreds of roots in a rotting state in other places, from the want of knowing that there was such a contrivance as the screw.

When I was at Overton, some pieces of very tough, knotty, close-grained oak were picked from the timber-heap, for the use of the Gregory lead-mine, by Sir Joseph Banks's direction, and the screw severed some pieces four or five feet in length, and nine or ten in. diameter, throwing them some feet asunder, to the surprise of the miners, who were assembled on the mine-bank. Sir Joseph took the screw with him to Revesby-Abby, in Lincolnshire, where I understand he had some large roots that had lain by many years as useless; and I dare say he will give you a good account, and bear testimony to the utility of the invention. We have used it without a single accident; but my neighbour, Lord Kirkwall, having procured one to be made by that which I had from you, one of his servants, in his lordship's absence, I presume, put too much powder into the hole, and the screw was blown as high as a one-pair-of-stairs window, and passed through it into an apartment where a person then happened to be, but without any farther mischief than the loss of a pane of glass. Any one who uses the instrument will soon learn what depth of screw will be sufficient to split any root in proportion to its strength, taking care that the screw has sufficient hold to resist the force of the gunpowder before the root is cleft. I think much powder may be saved by using a cotton match, impregnated by a solution of saltpetre, or any of the combustible matters generally made use of in fire-works; and by the use of the cotton the hole through the screw may be lessened, which will add to the action of the confined pow-

der; though a straw filled with powder, in the manner in which the miners use it, answers very well. Should any one be timid in using the screw, a chain or rope may easily be attached to the screw, and that fixed to any log, or fastened to a stake driven in the ground. If wood is rotten, the screw cannot act. I assure you, that when I go abroad I constantly see great quantities of roots in a rotten state, about almost every farm-house, which would not be the case if the utility of the instrument was made public. I am, &c.

J. LLOYD.

Wigfair, March 26, 1802.

Method of securing Beams or Girders of Timber, decayed by Time, or injured by the Dry-Rot.

By Mr. JAMES WOART, *of Fulham.*

With Two Plates.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

A Bounty of Ten Guineas was voted to Mr. WOART *for this Invention.*

WHERE the ends of the girder are decayed by time, or injured by the dry-rot, they are often taken out, and new ones put in their place, at a great expense; and if the dry rot is in the walls, the ends of the new girder will be in danger of it again: such was the case at Eltham, in Kent, where in one house there were three new girders to one floor in the space of twenty years; whereas my method will be found infallible, executed at much less expense, and not subject to the dry-rot, because the end of

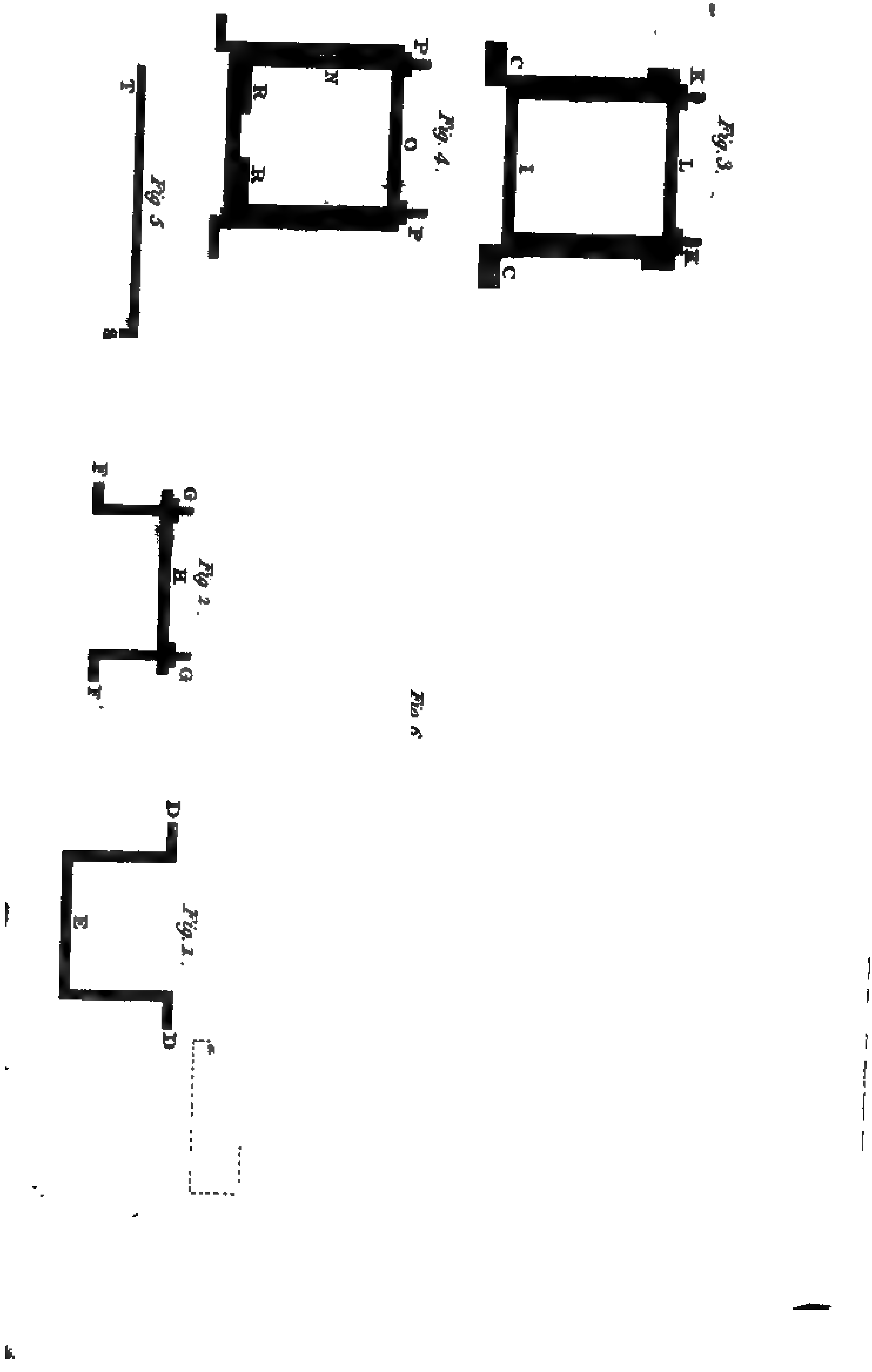
Fig. 1.
D
E
D
Fig. 2.
F
G
H
G
F
Fig. 3.
C
K
I
L
K
C
Fig. 4.
P
N
R
O
R
P
Fig. 5
T
S
Fig. 6

of the girder may be cut off clear from the wall; and if an air-grate is put on the outside, so as to admit air to the end of the girder, it will remain safe from injury.

A, (Fig. 5, Plate XIV.) shews the end of the decayed girder, with the braces applied upon it.

B, B, the templets or wall-plates on which the girder rests.

C C C C, one of the iron levers for raising and supporting the girder (there being a similar one on the opposite side). This lever is moveable on a pin D, which comes through a hole in the lever, distant about two feet from the end of the girder. This pin forms part of a collar E, bedded in the girder. The lever is six feet long, three inches wide, and three-fourths of an inch thick, and extends from the wall-plate along the side of the girder.

The extremity of the lever is moveable on another pin F, projecting through it from an upright iron G, bedded in the side of the girder, and carrying a nut and screw, which act on a cross plate H, through which the upright iron passes.

At the other end of the lever, next the templet, is an iron collar I, bedded in the girder, which collar may be raised or lowered at pleasure, by means of the nut and screw K, forming part of it; and by aid of the cap-plate L, which presses upon the lever, and also clasps it to the girder by its bend at L.

This figure shews only one side of the girder, and, as has been before observed, there being also a similar lever on the opposite side of the girder, their separate parts, method of connecting them, and their mode of action, are more fully explained in Figs. 1, 2, 3, (Plate XV.) where the same letters are made use of to point out the several parts.

 Fig.

Fig. 1, (Plate XV.) E, shews the whole of the collar to be bedded in the side and bottom of the girder, and the pins D, D, on which the two levers are moveable.

Fig. 2, the cap-plate H, the two upright irons G, G, with their nuts and screws, which act upon the extremities of the two levers by means of their pins F, F.

Fig. 3, the collar I, on which that end of the girder next the templet rests, the sides of which collar are bedded in the girder. C, C, are the claws or bended legs of the two levers which go into the templet. L, is the cap-plate. K, K, are the nuts and screws.

That part which has moveable iron levers or braces, (Plate XIV. Fig. 5,) represents the method I have employed, at the house of Hennege Legg, Esq. at Putney, in Surrey, to support the girders or beams where their ends or bearings were entirely destroyed. Had the iron braces not been put in execution, new girders must have been inevitably introduced. The bearing is not less than twenty-nine feet. The roof must have been completely taken off, owing to the gutter-plate being placed across the girders, and the roof a double one.

The cieling of the drawing-room, which is immediately under the girders, must also have been destroyed.

This cieling is highly ornamented, and supposed to be in value five hundred pounds; to which sum, if the expense of taking off the roof, &c. be added, it would have cost eight hundred pounds to have reinstated the work; whereas, I believe, that the iron braces and workmanship in effecting this business, on my plan, did not amount to twenty-pounds, for securing the four ends of the girders, the cieling, and the roof.

At Mr. Legg's house, where the levers above mentioned were applied, the beams of the roof were so decayed

cayed that the roof was in imminent danger, the bearings were entirely rotten, and the beams were sunk three-fourths of an inch, and pressing against the wall for support; if there had not been a large cornice underneath, supported by brackets, the whole roof must have fallen.

To put them in order, I first put shores or supports under each end of the two beams, on which the double roof lay, and then forced the four shores at once, for the security of the roof, the work, and the men. The iron levers C were then prepared, let into the templet, and fixed on each side of the beam, on the pins D, projecting from the collar E, bedded in the beam, about two feet from its end. When the whole apparatus was ready, on screwing the nuts on the upright irons G, at the extremity of the levers, the beam was raised to its proper height with great ease, although it was supposed there was above two tons weight on each beam, on account of the lead gutter, and gutter-beam betwixt the double roof, and the rich ornamented cieling attached to the joice, which was not the least destroyed except where the iron collar E was fixed, which was put up from the under side by cutting the cieling the width of the collar. These beams were so decayed, and so hollow, that the common method of bolting plank on each side of the beam would not have been safe; and if it could have been executed, the new planks would have been subject to the dry-rot, and the roof still in danger, which is now prevented, as the iron is not affected by it. The beam-ends were cut clear from the walls, and the beams were suspended by means of the iron levers, whose feet rest on the templets of the walls. An air-grate was made, on the outside of the wall, to admit a current of fresh air to the ends of the timbers. The roof is now much safer than when originally

ginally made, as the timber is secured from decay; and, owing to the collar E, the bearings are now two feet shorter at each end of the beam; the bearing on each beam being now, in the whole, four feet shorter than in its original state.

After the beams were brought to their proper height, and the levers and screws adjusted, screw-bolts were put into the timber, through holes purposely left in the lever, betwixt D and F, and the whole work thus perfectly secured.

At the other end of the girder M, (Plate XIV.) is shewn another method of supporting timbers, where the ends are decayed.

The particular irons used in this way are shewn in Plate XV. Fig. 4. N, is a collar for the girder; O, an iron frame, which rests on the templet; P, P, two nuts, which raise the collar N. R R, shew the clawed ends of the two bars of iron extending under the girder, bedded therein, and screwed to it at their extremities, about five feet distant from the templet.

Fig. 5, is one of the iron bars last mentioned.

S, is the claw or lap which projects over the collar N.

T, is the place where it is screwed into the girder.

Figs. 6 and 7, explain a third method of securing decayed timbers.

Fig. 6, gives a side-view of a decayed girder; *a*, represents the templet; *b*, an iron lever, six feet long, nearly straight, being only cambered one inch, three inches wide, and three-quarters of an inch thick; this lever extends along the side of the girder *c*, and is secured firmly to it by the side-irons *d*, *d*, *d*, *d*, which are two inches wide, and full half an inch thick, pointed at the ends. The higher ends of these side-irons are driven into the girder, and the lower points pass through holes in the lever

lever into the lower part of the girder, and are held close to the girder by staples *e, e, e, e*: the side-iron next the templet may be fixed slanting, in order that it may enter sounder wood. A claw *f*, which is part of the lever, rests on the wall-plate *a*, and is bedded in it; an iron plate *g*, lying under the girder and let into it, passes through the lever at *h*, connecting it with a similar lever on the opposite side, and which assists in the same way to support the girder: *i*, is a flooring-joist, to shew how deep the levers are inserted therein.

Fig. 7, shews the under part of the same girder: *b, b*, are the bottoms of the two levers above mentioned, fixed to the girder by the side-irons and staples before described; *k, k*, the broad feet of the levers which lie flat upon the wall-plate; *f, f*, the two claws projecting from the feet, in order to bed in the wall-plate; *i, i, i, i*, are joists, partly cut through, to admit the iron levers to lie close to the girder; *g*, shews the iron plate or collar on which the girder bears; it is turned up an inch and a half at each end, to keep the levers close to the sides of the girder. This collar should be made out of inch-bar iron, with points projecting from it, in the same manner as the collar at D D, Fig. 1, to connect it with the levers, by passing through holes made through them for that purpose.

To fix the levers, put a shore two feet six inches from the wall, under the girder, to support it; then cut off the decayed end, and take out the templet, or part of the wall-plate if decayed; and put in a stone templet for the irons to rest upon, with mortises in the stone to admit the claws of the lever: then fit the collar underneath the girder, two feet from the wall, to answer the holes in the lever; make an incision in the joists three-fourths of an inch wide, and three inches deep, to admit the levers;

fix

fix the levers on each side with the collar, so as to force up the levers together; then, with slight shores, force up the ends of both levers together, and fix the side-irons firm. The girder will thus be perfectly safe.

The templet or wall-plates on which the levers rest, are made of Portland stone, three feet long, nine inches wide, and five inches deep, with incisions or mortises made therein for the claws of the levers.

Certificates, confirming Mr. Woart's improvements, were received from the Commissioners of the Navy; from Mr. Joseph Harris, smith, at Putney; and Mr. George Smith, surveyor, at Putney.

Observations on the Soda, Magnesia, and Lime, contained in the Water of the Ocean; shewing that they operate advantageously there by neutralizing Acids, and among others the Septic Acid, and that Sea-Water may be rendered fit for washing Clothes without the Aid of Soap.

By SAMUEL L. MITCHILL, *of New York.*

From the TRANSACTIONS of the AMERICAN PHILOSOPHICAL SOCIETY.

MANY attempts have been made to render the water of the ocean fit for the purposes of *drinking* and *cooking*, and some of these have been attended with flattering prospects of utility. By a cheap and easy process, water tolerably fresh may be distilled from common salt-water, so as to help materially, in a case of scarcity or want, on board a ship of good equipment. The names of Hales, Lind, and Irvine, are remembered, to their honour, for their exertions in this work.

To

To furnish needy men with the means of *eating* and *drinking*, is certainly a noble discovery. But there is another operation scarcely less necessary to the preservation of health than eating and drinking, and that is *washing*, as applied to the human body, and more particularly to the clothing which it befouls. In a communication to professor Duncan, which has been published in the Edinburgh Annals of Medicine for 1799, and in the third volume of the New York Medical Repository, I have endeavoured to state the facts in detail concerning the matters secreted from the skin and wiped off by the clothes, and to shew how some of these became unwholesome, or infectious and pestilential, as they grew nasty. It was there stated that *soaps* and *alkalies* would render foul clothing clean, and both prevent and destroy animal poison if it was engendering there. And in a letter I wrote to Timothy Pickering, late secretary of state to the American government, in November, 1799, I recommended barilla or soda as a substance by which the salt-water of the ocean could be so softened and altered in its qualities as to become fit for washing the clothes of seamen.

A sea-vessel is peculiarly fitted for concentring foul and corrupting things, and for converting them into pestilence and poison. This is one of the most common accidents in sailing to the latitudes where there is heat enough to promote corruption, and to exalt septic substances into vapour.

One of the most disgusting sights during a voyage is the personal nastiness of many of the crew. It is pretended that much of this is necessarily connected with the service, that the work is dirty, and especially that fresh water cannot be spared from the vessel's stores to wash the company's clothing; that soap cannot be used with

ocean-water, that salt-water alone will not get them clean, and that therefore they are under a necessity of being uncomfortably nasty on long voyages, especially toward the latter part of them. Now, nastiness of a man's person and garments is necessarily connected with a similar condition of his bed, bedding, hammock, and birth, and most commonly of every thing he handles, or has ought to do with. If a seaman has strength of constitution to keep about and do duty, his feelings are nevertheless very uncomfortable, he is thereby predisposed to disease, and in danger every moment of becoming sick; and if this should really happen, his chance of recovery is exceedingly lessened by the filth with which every thing that touches him is impregnated, and the venom into which that filth is incessantly changing.

Thus, the great difficulties with which a seaman has to struggle are, first, the unfitness of ocean-water to wash with; and, second, the inutility of soap to aid that fluid in cleansing his clothes. If these can be surmounted, he will have no excuse for his uncleanness. If after this he becomes uncomfortable or sickly from that cause, it will be owing to his own laziness or negligence.

Few subjects have been discussed with more solicitude than the one, How did the ocean acquire its saltness? Whether that mass of waters derived its briny quality gradually by dissolving strata of salt, or whether it was furnished by its Creator with a due quantity of that material from the beginning, are questions not necessary now to be answered. It is sufficient to observe, that it is kept sweet, and guarded against offensiveness and corruption by the great quantity of ALKALINE matter it contains. The ocean may indeed be considered as containing some portion of every thing which water is capable

of

of containing or dissolving, and its water is therefore found to furnish different results on analysis, when taken up from different depths and different latitudes.

Yet various as the composition of ocean-water is, it always contains *soda*, *magnesia* and *lime*, in quantity considerable enough to be easily detected. Of these *soda* is the most abundant. *Magnesia* is next in quantity. And *lime*, though plentiful, is believed to exist in smaller proportion than either.

The *alkaline matter* so plentifully dispersed through the water of the ocean, exerts its customary neutralizing power after the same manner and according to the same laws which govern its several kinds on the land and in other places.

The acids commonly present in ocean-water are the *sulphuric*, the *septic* and the *muriatic*. The former of these exists apparently in small quantity, and is only mentioned because in some experiments it has been said to have been obtained from it in the form of a sulphate of lime, though according to the law of attractions, we might expect to find in it sulphate of soda. The vast amount of animal matter existing in the sea, would lead one *à priori* to a persuasion that in certain cases, particularly along marshes and shores where the stagnating water was much heated, putrefaction would engender *septic* acid, and that this would in some measure mingle with the water in its vicinity, and not fly away wholly in vapour. The quantity of this acid is so considerable in some coves and bays where salt works have been established, that a quantity of it adheres to the muriate of soda or common salt and vitiates its quality. And this happens in some situations to so high a degree, that Neumman (Chemical Works by Lewis, p. 392,) takes notice of it, observing " that sea water often con-

tains a *nitrous* matter, the ACID SPIRIT DISTILLED FROM SEA SALT PROVING A MENSTRUUM FOR GOLD, which the marine acid by itself never does, and which nothing but the nitrous will enable it to do. Though however this is frequently the case, it is not always: I have examined marine salt whose acid had no action upon gold."—As to the *muriatic* acid, whether it is as some of the older chemists suppose a modification of the sulphuric and the nitrous, or as certain of the moderns believe, but a compound basis of sulphuric and hydrogene, there is evidence enough of its existence in the ocean, in very great plenty.—On the whole, it may be concluded that sea-water *always* contains *muriatic* acid, *frequently septic* and *sometimes sulphuric*.

There are thus three predominating *alkalies* and as many *acids* in the ocean; and by the intervention of water they are liquefied and put in a condition to act each upon the other. Consequently the soda in the first place, as the stronger alkali, attaches and neutralizes the acids in the order of chemical affinity, and forms sulphate, septate and muriate of soda. But as the *two* former are comparatively rare or scarce, the latter is the predominating compound. When there is any acid in the water beyond the capacity of the soda existing there to neutralize, that part is attracted by the *two* earths, and according to the force of their respective combinations, forms sulphates, septates and muriates of lime and magnesia. These salts with earthy bases, in which the muriatic acid is by far more abundant than the other two acids, constitute the *bittern* and *scratch* or *slack* of the salt makers. These salited earths attract water so strongly that it is difficult or impossible to make them crystallize; but wherever they are they keep up a dampness and refuse to dry.

When

When chemists speak of sea salt they wish to be understood as meaning " the pure muriate of soda." This neutral compound however in its *pure* state is a great rarity. Perhaps indeed there is no such thing. Experience shews it is always mingled with greater or less quantities of the *deliquescent salts with earthy bases.* And these are so abundant in some sorts of salt that they render it unfit for the preservation of animal provisions. Beef and even pork are not guarded by salt so adulterated, from becoming tainted and putrid. That sea salt of this impure quality should be fit for curing provisions, it ought to undergo a particular refining operation to rid it of its foreign admixtures. For want of such a process, some sorts of sea salt, though fair to the eye, do not possess an entire and undivided antiseptic power, but so far as the muriate of soda in the mass is alloyed by the middle salts of magnesian and calcarious composition, those parcels of common salt so vitiated become unfit for opposing completely the process of putrefaction. And so far they make a departure from the antiseptic power of pure muriate of soda, the manner of whose action I endeavoured to investigate in a Memoir addressed to professor Woodhouse, and published in the second volume of the New York Medical Repository.

By reason of these foreign and adventitious matters, it happened in Sir John Pringle's experiments, that the common salt employed by him, instead of preventing the corruption of meat, when added in small quantity, rather promoted its decay. (Paper III. Exp. 24.) His trials he observes were made with the white or *boiled* salt kept here (in London I suppose he means) for domestic uses. (Appendix to Observations on Diseases of the Army, &c. p. 345, Note.) This kind of salt is known to abound

abound with the *earthy* salts with which ocean-water is charged.

Dr. Percival's experiments on sea-salt have a tendency to shew that the septic quality ascribed by the worthy baronet to small quantities of common salt is owing to the mixture of *bitter salt* with it. A quantity of this, he observes, adheres to all the common salt used for culinary and dietetic purposes, and, as far as its influence goes, it counteracts the wholesome and preservative powers of the clean and unmixed muriate of soda, (1 Essays Medical, &c. p. 344,) and that this *septic* quality of the sea-salt depended upon the presence of some heterogeneous substance was the opinion of Pringle himself. (Ibid. p. 347.)

Such then being the composition of ocean-water, it is easy to explain wherefore it is not fit, *by itself*, for washing garments, and making them clean. It has a deficiency of *alkaline salt* in it; and alkaline salts are well known to be the most excellent and complete detergents. And it is quite as easy to assign a reason why it will not answer to employ *soap* with ocean-water. The acids united to the lime and magnesia being more strongly attracted by the alkali of soap, quit their connexion with those earths, which fall to the bottom, while the lighter and deserted oil rises to the top. The activity of the alkali of the soap, thus overcome by the neutralizing acid of the water, can be of little service, and the disengaged grease immediately thereafter becomes a real impediment.

The basis of all *hard* soap is *soda*. The alkaline matter of *soft* soap is *potash*. This probably happens because the former is prone to *effloresce*, the latter to *deliquesce* in the air. The reason of mingling oil, turpentine and tallow with potash, is that this salt is too corrosive to be handled naked or alone. By its causticity *potash* destroys the

the skin and flesh of the washer, and unless carefully employed will destroy the goods too. But this is not the case with soda; which, in conjunction with carbonic acid, may be dissolved in water without exercising any caustic effect upon the arms and fingers of the person who uses it. By virtue of this convenient and excellent quality, the carbonate of soda can not only be used in a lixivial form to cleanse goods, but may be employed to alkalize or soften ocean-water, and to render it fit for washing with.

It has been ascertained long ago by Professor Home, in his experiments on bleaching, that neither sea-salt, nor any other of the *perfectly* neutral salts, composed of an acid and an *alkali*, give any *hardness* to water; that the common sorts of sea-salt make water *hard* by means only of the heterogeneous salts they retain from the *bittern*; and that *alkalies*, by precipitating the earth of salts with an earthy basis, and by neutralizing their acids, will *soften* water.

Ocean-water, it has been shewn, besides a *perfect* neutral salt, contains a quantity of saline matter with *earthy* bases. To these latter, it owes its *hardness*, or quality to decompound soap. But carbonate of soda decomposes these *terrene* salts, an forms with their acids respectively *perfect* neutral salts. The water thereupon becomes *soft*, or, in other words, fit for washing goods.

I find on experiment, that carbonate of soda thrown into ocean-water immediately renders it turbid, the lime and magnesia instantly turning milky on their disengagement from their respective portions of acid. To make the water fit for washing, so much soda must be added as not only to effect a complete precipitation of these earths, but to render the water sufficiently lixivial or alkaline. It will then exert its detergent and purifying powers.

Having

Having entertained doubts at first, whether the water ought not to be decanted off after the lime and magnesia had settled to the bottom, or whether it would not require straining or filtering to render it fit for use, I convinced myself by experiment that foul linen could be rendered clean and white by being washed in alkalized ocean water which contained its whole quantity of precipitated earth diffused through it. I rather think the small quantity of those impalpable and white particles which adhere to the linen worn upon the body will be advantageous and wholesome, as the shirts and other garments will thereby be enabled to neutralize a portion of the acid and oftentimes noxious matter formed from the sweat and other excretions of the skin, &c. Thus they will be rather serviceable than otherwise, and as both are in their carbonated state (having borrowed fixed air from the soda) they cannot do any harm.

The general inferences from the whole of the preceding reasoning are these: 1. Alkaline substances, such as magnesia and more powerfully lime and soda, are plentifully distributed through the ocean, to keep it from becoming foul, unhealthy and uninhabitable, which doubtless would be the case if the sulphuric, septic and muriatic acids abounding in it were not neutralized. 2. Where either of these acids is but imperfectly saturated, as happens when they are united to magnesia and lime, they decompound soap, let loose its grease, and become unfit for washing by aid of that material. 3. If soda or barilla is added to ocean water in sufficient quantity and the water lixiviated or alkalized, the earths will of course be precipitated and the acids neutralized. 4. In this state, dirty linen may be cleansed in it; and men at sea be thus enabled to have their clothes washed without the aid either of soap or of *fresh* water. 5. For

this

this purpose, a quantity of barilla or soda should always be provided as an article of the ship's stores, and issued to the men on washing days. 6. Thus by the operation of this alkaline salt, a great proportion of the nastiness and infection bred in the clothes, bedding, and births, of persons at sea might be prevented, and the crews and passengers so far preserved from fevers and dysenteries. 7. No more room would be occupied by water casks in the holds of vessels than at present. 8. The small quantity of magnesia and lime adhering to clothes washed in this way, is an advantage over and above what takes place in using fresh water. And, 9, a broad and noble view is opened of the economy of Providence in distributing alkaline salts and earths, so liberally throughout the terraqueous globe.

On the Nature of the Varieties of engrafted Fruit-Trees, and a Plan for increasing the Number of new valuable Fruits. By Thomas Skyp Dyot Bucknal, *Esquire.*

From the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce.

Some friends have requested that I would introduce another paper on the nature of the valuable varieties of engrafted fruits, as they are of opinion that the essay in the seventeenth volume of the Transactions of the Society is not sufficiently extended for a subject so important to the fruit-growers, and those interested in the productions of fruits. As a proof of my willingness to make the orchardist as perfect as I can, I beg you to present my compliments to the Society, with the following elucidations.

This

This is a subject in rural economy which ought to be much better understood than it is, in order to enable the planters to judge of the sorts proper to be planted, either as an article of pleasure, profit, or recreation; as much of the credit of the plantation must arise from judiciously choosing trees of the best, new, or middle-aged sorts, and not of the old worn-out varieties, which latter cannot, in the planting of orchards in common situations, ever form *valuable trees*, and must end in the disappment of the planter.

Engrafted fruits, I have before said, and I now repeat, are not permanent. Every one of the least reflection must see that there is an essential difference between the power and energy of a seedling plant, and the tree which is to be raised from cuttings or elongations. The seedling is endued with the energies of nature, while the graft, or scion, is nothing more than a regular elongation, carried perhaps through the several repeatings of the same variety; whereas the seed, from having been placed in the earth, germinates and becomes a new plant, wherever nature permits like to produce like in vegetation; as in the oak, beech, and other mast-bearing trees. These latter trees, from each passing through the state of seedlings, are perfectly continued, and endued with the functions of forming perfect seeds for raising other plants by evolution, to the continuance of the like species.

This is not the case with engrafted fruits. They are doomed by nature to continue for a time, and then gradually decline, till at last the variety is totally lost, and soon forgotten, unless recorded by tradition, or in old publications.

Reason, with which Providence has most bountifully blessed some of our species, has enabled us, when we

find

find a superior variety, to engraft it on a wilding stock, or to raise plants from layers and cuttings, or even to raise up the roots, and thus to multiply our sources of comfort and pleasure. This, however, does not imply that the multiplication of the same variety, for it is no more, should last for ever, unless the species will naturally arise from seed.

Nature, in her teaching, speaks in very intelligible language; which language is conveyed by experience and observation. Thus we see that among promiscuous seeds of fruits of the same sort, one or more may arise, whose fruits shall be found to possess a value far superior to the rest in many distinguishable properties. From experience also, we have obtained the power, by engrafting; of increasing the number of this newly-acquired tree, can change its country, give it to a friend, send it beyond the seas, or fill a kingdom with that fruit, if the natives are disposed so to do. Thus we seem to have a kind of creative power in our own hands.

From the attention lately paid to the culture of engrafted fruits, I hope we are now enabled to continue a supposed happily-acquired tree, when we can find it, for a much longer duration than if such variety had been left in the state of unassisted nature; perhaps I may say for a duration as long again, or something more. After these sanguine expectations, I may reasonably be asked, to what does all this amount? for here there is no direct permanency—and why? The *why* is very obvious—because the kernels within the fruit, which are the seed of the plants for forming the next generation of trees, will not produce their like. I allow they may do so accidentally; but nothing more can be depended on.

For example, suppose we take ten kernels or pips of any apple raised on an engrafted stock: sow them, and

they will produce ten different varieties, no two of which will be alike; nor will either of them closely resemble the fruit whence the seeds were collected. The leaves also of those trees raised from the same primogenious or parent stock, will not *actually* be a copy of the leaves of any one of the varieties or family, to which each is connected by a vegetable consanguinity. I intentionally used the word *actually*, because a resemblance may be found, though not much of that is to be expected.

I beg that what has been last mentioned may not be be taken as a discouragement to attempts for raising new varieties. I was obliged to speak very strongly, in order to place the culture upon its true foundation. I think it need not be observed, that there is no acquiring a new variety but through the means of a seedling plant; and therefore whoever wishes to succeed must attempt it that way, or wait till others in their plantations may more fortunately produce it.

In choosing the seeds, that apple is most likely to produce the clearest and finest plants, whose kernels are firm, large, and well ripened. The size of the fruits is not to be regarded; for large apples do not always ripen their fruit well, or rather for cider the small fruits are generally preferred for making the strongest, highest-flavoured liquor. And for what I have been able to collect in the cider-countries, it is there the opinion, that an apple something above the improved crab promises the best success. This advantage also attends the practice: if there are no valuable apples raised from that attempt, these wildings will make excellent stocks to engraft upon.

Gentlemen who actually employ themselves in attempting to acquire new varieties, should remember that they ought to select all the sets, from the bed of apple-quick, whose

whose appearance is in the least degree promising, and plant them together, at such a distance as to allow each to produce its fruit, which will happen in about twelve, fifteen, or eighteen years. My friend Mr. Knight, who undoubtedly is the first in actual exertions for procuring these happily-acquired new varieties, has had two plants bear fruit at six years old, and one at five. The cider-countries have offered several premiums for procuring new varieties, and some with good effect. Premiums have been given both to Mr. Knight and Mr. Alban.

When the new variety is to be raised from a valuable *admired* apple, I should recommend the placing these seeds in a garden-pot, filled with mould from an old melon-bed; carrying the pot into a retired situation near the water, and giving attention to run the plants to as large a size as is convenient within eighteen months. With this view, the pot should be placed in the green-house the first winter; and when the plants are afterwards to be set out in the spots, they should not be placed under the drip of trees, or much exposed to the winds.

Two instances have been mentioned, the improved crab, and most admired apple; but prudence says, try all sorts, and something probably will arise; and the process is attended with little trouble or expense to a person who constantly resides in the country: yet, after all this scientific care, the apple may want flavour, and be in other respects nothing better than a common wilding.

It is an undoubted fact, and worthy of observation, that all the different trees of the same variety have a wonderful tendency to similarity of appearance among themselves; and that the parent-stock, and all engrafted from it, have a far greater resemblance to each other, than

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can be found in any part of the animal creation; and this habit does not vary to any extent of age.

As an encouragement in attempting to increase the number of new valuable fruits, we can prove that the golden-pippin is native English. The red-streak a seedling of Herefordshire, if not raised, yet was first brought into notice by Lord Scudamore, and was for a long time called Scudamore's Crab. The Stire Apple was accidentally raised in the Forest of Dean, in Gloucestershire, and took the name of *Forest Stire.* The cider made from this apple was the strongest the country ever produced, according to any living record. The Haglo-crab, the best cider-fruit now remaining, was discovered in the parish of Ecloe, on the banks of the Severn; and, about sixty or seventy years ago, many scions were taken from this tree by Mr. Bellamy, and engrafted on seedling-stocks about Ross. These are now grown old; and, to ascertain the age of the variety, I went with Charles Edwin, Esq. to Ecloes, in hopes of seeing the parent-stock of this family. The proprietor of the estate acquainted Mr. Edwin that it had ceased to bear years ago, and was cut down. Those at Ross are but poor bearers now, and I should suppose the variety must be 140 years old, though Marshal, who wrote in the year 1786, mentions these trees were prolific, and he supposes the sort to be about eighty years old; but, from present experience, it must be much more. The Tinton-squash pear is of Gloucestershire; the Barland and Old-field were near Ledbury, Herefordshire. The two last pears clearly bear the names of the two fields where they were raised. The Barland fell about six years ago, visibly from weight and longevity, which was supposed to have been about 200 years. There have been many other names of estimation handed down to us, though the realities are now totally

worn

worn out, and have ceased to exist. Can any better proof be desired, that engrafted fruits are not permanent, than the regret we feel for the loss of these old valuable fruits?

To make my paper as short as convenient, I have dwelt only on the apple and pear; yet all the engrafted fruits are under the same predicament of the seed not producing its like, and the offspring in time falling into a nothingness of growth and bearing, though that space of time must certainly depend on the natural longevity and hardness of the sort, soil, position, care, &c. All these are more fully expressed in the papers published in the different volumes of the Transactions of this Society, and the two volumes of the Orchardist, wherein the whole system is extended, to form a rational culture for the management of standard fruits *.

It should be remembered, that as I am now alluding to the state of actual permanency, fifty years are to be accounted as nothing; and as often as we come to that point, we are compelled to resort to our first assertion, "That engrafted fruits are not permanent, they being "continued from elongations, and not raised as a repe- "tition of seeds." This is the only rational way as yet introduced of accounting for the loss of the valuable old varieties of fruits. Should a better system be introduced, I shall readily adopt it; but this sufficiently answers the purposes of the planter.

Some years ago, from due investigation and thorough conviction, I propagated this principle; and it was published in the seventeenth volume of the Society's Transactions, in the following words: "All the grafts taken "from this first tree, or parent-stock, or any of the de-

* See the volumes of the first series of this work.

"scendants,

"scendants, will for some generations thrive; but when "this first stock shall, by mere dint of old age, fall into "actual decay, a nihility of vegetation—the descend-"ants, however young, or in whatever situation they "may be, will gradually decline; and, from that time, "it would be imprudent, in point of profit, to attempt "propagating that variety from any of them. This is "the dogma which must be received. I do not expect "a direct assent, neither do I wish it, for it should "be taken with much reserve; but it is undoubt-"edly true." These considerations should stimulate us in searching after new varieties, equal or perhaps superior to those of which we regret the loss.

Observe that, from the time the kernel germinates for apple-quick, should the plant be disposed to form a valuable variety, there will appear a regular progressive change, or improvement, in the organization of the leaves until that variety has stood, and grown sufficient to blossom, and come into full bearing; that is, from the state of infancy to maturity; and it is this and other circumstances by which the inquisitive eye is enabled to form the selection among those appearing likely to become valuable fruits. But from that time the new variety, or selected plant, compared with all the engraftments which may be taken from it, or any of them, these shall shew a most undeviating sameness among themselves.

It is readily allowed, that the different varieties of fruits are easily distinguished from each other by many particulars, not only respecting their general fertility, and the form, size, shape, and flavour of the fruit, but also the manner of the growth of the tree, the thickness and proportion of the twigs, their shooting from their parent-stem, the form, colour, and consistence of the leaf, and many

many other circumstances, by which the variety can be identified; and were it possible to engraft each variety upon the same stock, they would still retain their discriminating qualities, with the utmost undeviating certainty.

The proper conclusion to be drawn from the statement in the last paragraph, is this—that were any one to put the thought in practice on a full-grown hardy or crab stock, it would produce an excellent proof that engrafted fruits are not permanent. For if twenty different varieties were placed together, so that each might receive its nature form the same stem, they would gradually die off in actual succession, according to the age or state of health of the respective variety, at the time the scions were placed in the stock; and a discriminating eye, used to this business, would nearly be able to foretell the order in which each scion would actually decline. Should it also happen that two or three suckers from the wilding stock had been permitted to grow among the *twenty grafts*, such suckers or wilding shoots will continue, and make a tree after all the rest are gone. A farther consequence would result from the experiment: among such a number of varieties, each of the free growers would starve the delicate, and drive them out of existence only so much the sooner. It must be observed, that this supposed stem is the foster-parent to the twenty scions, and real parent to the suckers; and those the least conversant with engrafted fruits know the advantage acquired from this circumstance. And here it is worth while remarking, that a Gascoyne, or wild cherry, will grow to twice the size that ever an engrafted cherry did.

By an experiment we have had in hand for five years, it will appear that the roots and stem of a large tree, after the first set of scions are exhausted or worn out, may carry

another set for many years; and we suspect a third set, provided the engrafting is properly done, and the engrafter chooses a new variety. Now the Ripston Pippin, of Yorkshire, is the favourite, as being a free grower and good bearer, with fine fruit. This however may certainly be depended on, that when a new apple is raised from seed, if a scion were placed in a retired situation, and constantly cut down, as a stool in a copse-wood, and the apple never suffered to fulfil the intentions of nature in bearing fruit, the practitioners of the following ages may secure scions from that stool, to continue the variety much longer. Hence, though I have written as much as is in my power against permanency, yet I have taken some pains to assure the planters, that forecast, selection, pruning, cleanliness, and care, will make the orchards turn to more profit for the rising generations than what they have done for the last hundred years.

To place the nature of varieties in its true light, for the information of the public, I must maintain, that the different varieties of the apple will, after a certain time, decline, and actually die away, and each variety, or all of the same stem or family, will lose their existence in vegetation; and yet it is a known fact, and mentioned in the seventeenth volume of the Trasactions, that after the debility of age has actually taken possession of any variety, it will yet thrive by being placed against a southern wall, and treated as wall-fruit. Who, however, can afford to raise cider at that expense, except as matter of curiosity, to prove, that when the vital principle in vegetation is nearly exhausted, a superior care and warmth will still keep the variety in existence some time longer?

It should be understood, that the external air of Britain is rather too cold for the delicate fruits, which is the

reason

reason why, in the Orchardist, I lay such a stress on procuring *warmth* for the trees, by *draining*, *shelter*, and *manure*. It would be now lost time to attempt to recover the old varieties as an article of profit.

If I have not expressed myself, in this Essay on the Nature of varieties, with so much clearness and conviction as might have been expected, it should be considered that it is an abstruse subject, very little understood, and requiring at first some degree of *faith*, *observation*, and *perseverance*. The prejudices of mankind revolt against it. They are not disposed to allow the distinction of nature; and they imagine, that in the act of engrafting or multiplying they give new life, whereas it is only continuing the existence of the same tree, stick, or bud. Observe what I said before:—the seed of the apple, when placed in the earth, germinates, and unfolds itself into a new plant, which successively passes through the stages of infancy, maturity, and decay, like its predecessors. I might say, all-created nature is similar in this respect; though, from the circumstance that varieties are much longer lived than man, the plants have appeared to be possessed of eternal powers of duration; nothing sublunary, however, which possesses either animal or vegetable life, is exempt from age and death.

Within the last twenty years I have travelled many hundred miles, and conversed with the most intelligent men in each country; and I now want to convince mankind, for no other reason than because it is their interest so to believe, that there is in creation an order of beings (engrafted fruits) so formed, that we have the power of multiplying a single variety, to whatever number of trees we please;—that the first set arises from a small seed;—that the next and descendant sets are propagated by en-

 graftings,

graftings, or from cuttings, layers, &c.;—and that although these trees may amount to millions, yet, on the death of the primogenious or parent-stock, merely from old age, or nibility of growth, each individual shall decline, in whatever country they may be, or however endued with youth and health. I say they shall gradually begin to decline; and in the course of time, or of centuries, to those who would prefer that expression, the *whole variety* will scarcely have a single tree remaining to show what the fruit was. Let those who are not disposed to assent to this statement, ask themselves what is become of the old lost varieties? did they die, or did wicked men maliciously cut them up?

I, who am firmly convinced of the truth of what I have advanced on this subject, have no doubt but that the same would happen by engrafting on the oak or beech, if the mast raised from the engrafted tree did not produce the like; for there the question turns.

It is not known, that the woodman in setting out his sapling oaks, always selects new seedling plants, and never continues one upon an old stool; and that if he should so blunder, that tree, from the stool, will neither have the freedom of growth, nor the size nor firmness of timber, equal to a new-raised plant.

I wish I could persuade my friends, that with the same attention with which the woodman acts, the planter is to raise his orchard from the young fruits which thrive in the neighbourhood, or are in health, and full-bearing in the country whence they are to be brought.

The fruit-grower should look to selection, cleanliness, and care. To me it is a circumstance perfectly indifferent, whether he is to use Mr. Forsyth's composition,

position, Mr. Bullingham's boiled linseed oil, or my medication. I only maintain that the wounded parts of trees want something to destroy the insects and vermin, and heal the wood, from which the trees are kept in health.

Let those who are blessed with fruit-plantations attend to their preservation, and not leave them to the state of unassisted nature.

New Kind of Paint, proposed as an advantageous Substitute for painting in Distemper.

By M. CARBONELL.

From the BIBLIOTHEQUE PHYSICO-ECONOMIQUE.

IT is well known that a disagreeable smell is perceived on entering apartments newly painted in distemper; therefore till such apartments have been for some time exposed to the contact of the air, no one likes to inhabit them. The following process remedies these two inconveniencies.

The method of operation is very simple; it consists in substituting the serum of beef-blood instead of size, which is usually employed to dilute the colouring matter.

1. The butcher must be requested to catch the blood of one or more oxen in clean vessels. When the blood is become quite cold, that is, in about three or four hours after it has been drawn, the vessels are gently inclined, and by these means a transparent liquid is poured off, which has a slight smell of amber. It is strained through a piece

for painting damp walls without fear of its being detached, an advantage which painting in distemper certainly does not possess.

The same author likewise declares, that he has made numerous experiments with this same paint, and has always obtained such constant and satisfactory results, that he doubts not when it is known, that it will be generally adopted. He mentions, amongst others, the use he has made of it, at Barcelona, both in the interior and exterior of houses, and he has invariably remarked, that it not only remained unaltered by the sun, the air, humidity, and dryness, but that it was also exempt from any disagreeable smell; so that places painted with it might be inhabited on the very day of applying it.

At first sight one would be led to imagine, that the new kind of paint proposed by M. Carbonell is almost the same thing as the milk-paint described by M. Cadet Devaux *. The latter may have answered, but when we reflect on the material difference that exists between the composition of the serum of blood and that of milk, we shall instantly perceive the superiority of M. Carbonell's paint to the other.

For the rest experience must decide the matter; and it is to be presumed that it will not fail to shew which of the two methods deserves to be adopted in preference.

* Published in the fifteenth volume of the first series of this work, page 411.

Observations

Observations on Zoonic Acid. By M. THENARD.

From the ANNALES DE CHIMIE.

M. BERTHOLLET, some years since, announced, that in the distillation of animal matter a new acid is formed, to which he gave the name of *Zoonic Acid.* The only properties which he discovered in this acid are: 1. that it has a smell similar to that of roast meat: 2. that it is liquid at the ordinary temperature: 3. that it is volatilised before it attains the heat of boiling water: 4. that it forms soluble salts with barytes, potash, soda, strontian, lime, and ammoniac: 5. that it precipitates nitrate of lead, and acetite of mercury: 6thly and lastly, that it is decomposed with lime and deposits carbon.

M. Fourcroy, desiring to obtain a more particular knowledge of this acid, requested me to examine it with the greatest attention, for the purpose of discovering all its characteristics. With this view, I prepared several litres of zoonic acid, to procure which I followed the method indicated by M. Berthollet, in his memoir on that subject.

First experiment. I distilled, in stone crucibles, at several times and with great precaution, 30 kilogrammes of muscular flesh. The produce was collected in receivers, adapted to the crucibles by intermediate tubes. After having separated the oil contained in this produce, it was boiled together with lime, and a great quantity of ammoniac was disengaged. When the zoonate and the carbonate of ammoniac were decomposed, carbonic acid was filtered and poured into the liquor to precipitate the lime that was not combined. The liquor, after being again filtered, was evaporated to the consistence of syrup, and then poured into a glass crucible

with phosphoric acid. The crucible being placed on a sand-bath, the process of distillation was commenced. A slight acid liquid passed into the recipient: this was zoonic acid; it formed a scanty precipitate with acetite and nitrate of mercury; still less with nitrate of lead; but acetite of lead was not rendered turbid by it: when concentrated by fire, it formed successively in solutions of those different salts, flaky precipitates; in tolerable quantity in the two first, less abundant in the third, scanty in the fourth, in other respects it possessed all the above-mentioned properties.

Second experiment. Four litres of this zoonic acid were mixed with pot-ash purified by alkohol; only seven grammes of alkali were required for their saturation. Evaporation produced a laminated salt of a very pungent taste, which soon became entirely liquid, was decomposed by sulphuric, nitric, muriatic, &c. acids; in short, a salt which united all the properties of acetite of pot-ash. Treated with phosphoric acid this salt yielded, by the application of heat, a liquid, analogous to acetous acid, the last portions only of which precipitated acetite of mercury.

Suspecting, and even persuaded, in consequence of this, that zoonic acid was nothing but acetous acid combined with an animal matter, in order to convince myself of it, I made the following experiments.

Third experiment. Into very pure zoonate of lime (prepared by boiling the produce of distilled animal substances with lime,) I poured an excess of nitric and acetous solution of lead and mercury; four metallic zoonates were formed, two of lead and two of mercury, all four of a light grey colour, almost tasteless and insoluble, (the liquors, after filtration, were of a dark brown colour,. In distilling these different zoonates with phosphoric acid and sulphuric acid, if any zoonic acid had actually existed

isted in them, it must have become volatile, and have passed into the recipient; but in distillation nothing but a liquid was obtained, that did not, perceptibly, redden the tincture of turnsol, and the residuum of which consisted of sulphates or phosphates of lead and mercury, and of an animal matter. This animal matter is brown; if put on ignited charcoal, it burns with ebullition; it is almost insoluble in water. Acids promote its solution; and, thus dissolved, either in water or acids, provided the latter are not in too great excess, it precipitates most metallic solutions. Oxygenated muriatic acid converts it into a thick, solid, and yellowish oil. This accounts for its forming a precipitate, which assumes the form of soft, yellow, earthy particles, when this acid, in a gaseous state, is made to pass through the liquor produced by zoonate of lime decomposed by solutions of lead and mercury. But this precipitate is not composed only of oil; it contains, besides, oxyd of lead or mercury, and muriatic acid: that formed in mercurial liquor by oxygenated muriatic acid is weak, because the solutions of mercury effect an almost total precipitation of animal matter. The same is not the case with solutions of lead, and especially of the acetite; for the acetite of lead precipitates much less than the nitrate or zoonate of lime, since after pouring into zoonate of lime an excess of acetite of lead, if nitrate of lead be added, it again becomes turbid. It is for the same reason that the zoonic acid (first experiment) usually precipitates with nitrate of lead, and does not precipitate with acetite. Doubtless the acetous and nitric acids may form triple combinations with the animal matter and the oxyd of lead, and the second be less soluble than the first. Thus in examining the precipitate, formed in the zoonate of lime by nitrate of lead, I have frequently discovered nitric acid.

It appears that these triple combinations do not take place with mercury.

If, from all the experiments, it may be positively asserted, that the zoonic acid is nothing but acetous acid, holding in solution an animal matter, approaching to the state of oil, and that it is this animal matter that imparts to this acid the property of precipitating various metallic salts, and particularly those of mercury and lead, it may be said, with a greater degree of certainty, that if the examination of the acid furnished by animal matter by distillation were worthy of more attention, M. Berthollet would doubtless have examined it with greater care, and would have discovered its nature.

I shall conclude this notice with an account of an observation which appears to me both curious and important: it may with propriety be introduced in this place, because it is a sequel to the researches which I made on the distillation of animal matters.

I left exposed to the air, in a china vessel, zoonate of lime, evaporated to the consistence of syrup, and prepared as described above. Some time after I wished to re-dissolve it; but there remained flakes of animal matter which were separated and put aside. I boiled these flakes in water, and they dissolved. The solution was of a light yellow colour, and had rather a bitter taste; it did not alter the tincture of turnsol. I let this liquor stand four or five days, after which time it had no more effect upon the tincture of turnsol than before. I evaporated part of it. What was my surprise to find that the liquor acquired an extreme acidity in proportion as the evaporation proceeded! I examined what kind of acid was formed; and soon discovered it to be nitric acid. I actually obtained very beautiful crystals of nitrate of potash by combining it with that basis. Although I had perfectly cleansed the vessels, and had performed the experiments

periments with care, I still had doubts, and I could not credit the almost total conversion of animal matter into nitric acid in the space of a few minutes. But fortunately for the purpose of convincing myself, I had almost half of this animal matter left. I again ascertained that it was not acid, and that it contained no acidity. I evaporated it, and in five or six minutes it was converted into nitric acid. It appears to absorb the oxygen of the atmosphere.

As I had preserved the oil obtained from the produce of the zoonate of lime, by which this singular substance had been deposited, and suspecting that this oil, which had not been washed, might contain it, I treated it with water, and actually obtained nitric acid the third time by evaporation. I instantly resolved to distil a fresh quantity of muscular flesh for the purpose of more accurately studying so extraordinary a phenomenon; I imagined I could produce it at pleasure. But I have since twice repeated the experiment, both times without success. However I am certain that I was not mistaken with the first, and am equally positive that no error was committed with the last. The formation of this singular animal matter appears to depend on the degree of heat to which it is submitted. I cannot say that it should be violent or moderate, not having paid sufficient attention to the alterations which animal matters undergo at certain temperatures. These alterations vary so much that they are far from being exactly known; they are nevertheless well worth the observation of chemists, and I doubt not but that by a more accurate investigation than has hitherto been made, not only the matter here announced, of which I obtained but an imperfect idea, but likewise many other chemical facts of equal importance, will be discovered.

Observations

Observations on the real Nature of Precipitates formed by Prussiates in Acid Solutions of Barytes, and the Affinities of Prussian Acid. By *M.* Guyton.

From the Annales de Chimie.

Bergman had already announced that acid solutions of barytes were precipitated by liquor saturated with the colouring principle of Prussian blue. This fact confirmed by the observations of a great number of chemists, appeared to many a new indication of its metallic nature, before justly suspected, on account of its great weight. Lavoisier in particular considered it extremely probable that the difficulty of bringing it back to its metallic state arose only from its having a greater affinity for oxygen than carbon.

The failure of the attempts to effect its reduction, having occasioned the idea of this composition to be in some measure relinquished, the attention of chemists was again attracted by the phenomenon of the precipitation of an earth by a re-agent, which according to an opinion generally received was a characteristic sign of the presence of a metal. They began to suspect that it might arise from some accidental cause. In the year 1786, M. Meyer of Stettin, announced in Crell's Annals, that prussiate of potash prepared with care and perfectly pure did not precipitate barytes in its solutions: Kirwan and Klaproth had adopted the same opinion from their own experience. Yet most chemists continued to think that the precipitation took place in some degree after the liquor of the experiment was purified. Pelletier amongst others made this one of the most essentially distinguishing characteristics between barytes and strontian.

Some

Some time since, wishing to try a prussiate of lime recently prepared with lime of marble and extremely limpid, I poured into it a solution of carbonate of pot-ash. The liquor instantly assumed an opaque milky appearance. As there was certainly no metallic substance in this operation, I could attribute this decomposition only to an alteration in the bases of these two salts produced by a double affinity. I instantly determined to examine whether it was not absolutely the same phenomenon that had occcasioned the idea that barytes was of a metallic nature.

I was prevented from making these researches by Mr. William Henry, who has perfectly elucidated this point of theory. I shall briefly state the experiments which conducted him to this point. I shall afterwards offer a few reflections on one of the consequences he has drawn from it, and which appears to me to require correction.

The first object of Mr. Henry's labour was the direct composition of prussiate of barytes with a view to obtain a perfectly pure prussiate of pot-ash; the following is the process of its preparation, which he asserts that he accomplished, and which was suggested to him by observing the decomposition of sulphate and carbonate of pot-ash by prussiate of barytes.

He calcines the carbonate of barytes, dissolves that earth in boiling water, and adds Prussian blue till the water ceases to become discoloured. If the filtered liquor becomes turbid whilst cooling, and deposits a small quantity of oxyd of iron, he again filters it, and in a few hours small yellowish crystals are formed, which are prussiate of barytes. From the remainder he obtains a farther quantity of crystals by evaporation.

This prussiate of barytes, pulverized, is thrown into a warm solution of carbonate of potash, till it no longer restores

restores the colour of reddened litmus paper. The author advises that rather more of the prussiate be employed than is requisite to decompose the carbonate. After digesting the mixture about an hour, he filters the liquor, gently evaporates it, and thus obtains beautiful crystals of prussiate of pot-ash.

These crystals sometimes contain 24 *per cent.* of oxyd of iron; but of this the greatest part is separated by digesting the liquor, before evaporating it, with a little acetic acid, which has the advantage in this instance of forming with the pot-ash a salt incapable of crystallizing, and which cannot therefore mix with the crystals of prussiate.

Let us now see how Mr. Henry has employed the prussiate of potash thus prepared to resolve the point in dispute.

He poured a quantity of it into a solution of muriate of barytes; there was no precipitation, the transparency of the mixture was not in the least disturbed, and he was disposed to believe, with Messrs. Meyer and Klaproth that a pure prussiate does not precipitate barytes.

But looking at the mixture half an hour afterwards he perceived small crystals beginning to be formed on the inside of the vessel, and in a few hours they were considerably increased. These crystals, when examined, had the following character:

1. They were very sparingly dissolved in cold water, and it required nearly an ounce of water to dissolve a quarter of a grain.

2. Hot water dissolved them more readily but still in very small proportion.

3. These solutions yielded, with sulphuric acid and sulphate of potash, a precipitate of sulphate of barytes, and with sulphate iron they yield Prussian blue.

4. The

4. The crystals are dissolved completely in muriatic acid diluted with water; and this solution affords unequivocal signs of the presence of prussiate of barytes.

5. When heated to redness in a silver vessel these crystals become black and lose their form; muriatic acid being poured on this coal-like residuum, an effervescence ensued and the produce was muriate of barytes.

Mr. Henry draws several conclusions from these facts. The first is, that he was mistaken as well as those who asserted that pure barytes does not decompose prussiate of potash.

2. That barytes should be placed before potash in the table of affinities of Prussian acid.

3. That the precipitation effected by prussiate of potash, in the solution of muriate of barytes, is the produce of a double affinity.

Fourthly and lastly, that barytes differs in this respect from other earths, and approaches the nature of metals.

The three first of these propositions appear to me to be exempt from every objection; for though Mr. Henry states no direct experiment on this subject, yet we know, and I have observed it myself, that water of barytes added to a solution of alkaline prussiate decomposes it by simple affinity.

Mr. Henry's last conclusion is not so unobjectionable: for although the acid solutions of barytes are decomposed by alkaline prussiates, exactly like metallic solutions, by means of the double affinity or the combination of distinct powers which determine the alteration of the bases, it by no means follows that this circumstance distinguishes barytes from earths and brings it nearer the nature of metals. If that were the case, the same must be said of all substances exhibiting the same phenomenon; and we should doubtless be surprised to see this reasoning oblige us to assimilate to metals, lime, strontian, mag-

 nesia,

nesia, potash, soda, and even ammoniac, since Prussian acid can likewise take away all these bases from their dissolvents when the sum of the various affinities is in its favour.

I have proved this in potash by the experiment stated above, where it has been shewn that it separated the Prussian acid from lime by giving up its carbonic acid.

The effect is still more speedy with carbonate of soda and prussiate of lime.

The solution of nitrate of strontian is likewise decomposed by the prussiate of lime.

If a few drops of prussiate of lime be added to a solution of sulphate of ammoniac, in about five or six minutes you observe floating on the surface a whitish frothy scum, six or seven millimetres in depth, which deposits small flakes.

Lastly the mixture of sulphate of magnesia and prussiate of lime becomes muddy in the same manner in a few minutes, and forms a precipitate.

Let us then return to the real cause of these phenomena, the power of double attractions for which we are still guided by the simple elective attractions, the order of which is wholly independent of the series in which we place such substances as have several properties in common. Thus barytes should no more be placed before potash in the table of Prussian acid than lime before fixed alkalis in tables of oxalic, tartaric, boracic, &c. acids. It is therefore with much greater propriety that it is proposed to class barytes with alkalis, which it resembles in point of chemical action in a great variety of circumstances, but from which it is distinguished, as I have said elsewhere, by some characteristics which may be considered decisive, and especially by its insolubility in alkohol.

Report

Report on a Memoir sent to the Society of Apothecaries of Paris, by M. Robert, *of Rouen, on the Inflammation of combustible Bodies by their contact with Sulphuric Acid; with additional Experiments. By Messrs.* Charles Louis Cadet, *and* Boullay.

From the Annales de Chimie.

M. ROBERT recapitulates the different experiments made by Messrs. Fourcroy and Vauquelin on the effects of super-oxygenated muriate of potash combined with certain combustible bodies and submitted to the action of shaking or friction. All chemists are now acquainted with those beautiful explosions, and the inflammation produced by the same bodies when plunged in concentrated sulphuric acid is likewise familiar to them. The latter experiments are modified by M. Robert in an interesting manner. Instead of throwing the inflammable mixtures into that acid, he only touched them with a tube dipped in it. In this manner he inflamed:

1. Three parts of super-oxygenated muriate and one part of sulphur.

2. Three parts of the same salt, half a part of charcoal and the same quantity of sulphur.

3. Equal parts of antimony and super-oxygenated muriate.

4. Equal parts of sulphur, antimony, and salt.

5. Equal parts of kermes and sulphur.

6. Equal parts of arsenic and salt.

7. Three parts of muriate and one of sugar.

8. Three parts of muriate and one of charcoal.

9. One part of muriate and three parts of gunpowder.

10. One part and a half of muriate and three parts of gunpowder.

Lastly, compositions of alkohol, olive-oil, and super-oxygenated muriate of potash.

We have repeated all these experiments with perfect success; and likewise the following, which justly appeared to M. Robert to deserve some attention.

He charged a pistol with common powder; he put into the pan the above mentioned mixture of powder and muriate; he set it on fire with the sulphuric match, and the pistol went off.

M. Robert observes that the brightness and colour of the flame, and the smell proceeding from different combustibles, differ essentially; but he did not endeavour to ascertain what gases were formed and what residuum remained after inflammation. We intended to have collected the gases produced, in an hydro-pneumatic apparatus, for the purpose of examining them; but the time fixed by the Society for making our report being only a few days, we postponed those researches.

Although these experiments appear calculated only to gratify curiosity, yet we determined to try in the same manner various simple and compound substances, on the inflammation of which no experiments had yet been made.

New experiments made by the Commissioners.

As the method of operation is nearly the same, to avoid incessant repetition, we shall only mention the substance combined with the super-oxygenated muriate of potash. Phosphorus affords a beautiful deflagration: hydrogen gas takes fire. To perform this experiment we filled a bladder with inflammable air, and to its mouth we screwed a copper tube. This tube was dipped in sulphuric acid and brought in contact with super-oxygenated muriate of potash, pressing the bladder at the same time that the

the current of gas might be discharged on the salt. At the moment of contact the gas took fire as by an electrical spark.

Gold, silver, zinc, and iron, presented no other phenomenon than the decrepitation of the muriate only. The negative result did not surprise us with regard to the two first metals which are not easily oxydable; but zinc and iron led us to expect an inflammation, as they detonate with a shock.

Brown oxyd of copper, the residuum by distillation of acetite of copper, burned without flame, but with flashes like artificial ones.

Metallic sulphates succeeded perfectly well, especially sulphate of tin, or black sulphate of mercury. The latter gives a very beautiful brilliant flame. Amber, acid of amber and coal, are not set on fire, but their decrepitation is very considerable.

Among vegetable substances there are some which take fire easily, as volatile oils, resin, turpentine, gum copal, gum arabic, powder of lycopodium, camphor, cotton, soap, sawdust. With the last mentioned material success is not always sure; but by adding a small quantity of sulphur an excellent fusing powder is produced that may be useful to mineralogists from the facility with which they may be inflamed by means of a re-agent.

We tried starch; it is difficult to inflame it, but we succeeded in making it burn. Ether takes fire very quickly; in this experiment, as well as in that with camphor and alkohol, we observed that the super-oxygenated muriate was but very partially decomposed, that it did not burn, but served only to promote the inflammation. To ascertain this fact we mixed sulphur with the residue of this experiment, and a sulphuric match produced a second combustion.

We

We made a paste of super-oxygenated muriate of pot-ash and honey; this mixture inflamed with ebullition, emitting a smell of sugar-candy, mixed with a very penetrating acid which we imagined to be acetic acid.

Crystallized benzöic acid emits a considerable flame, of a reddish colour; tartaric acid, likewise, burns very well; the tartrite of pot-ash gives a whitish flame; tartrite of soda presents neither inflammation nor light. The antimoniated tartrite of pot-ash gives beautiful sparks without flame.

Oxalic acid, with oxygenated muriate, sparkles without inflammation. Acetic acid produces a considerable deflagration, and a bright, blueish flame. The acetates of pot-ash and soda take fire with a cracking.

These results induced us to try what animal matters might be inflamed by the same processes; we tried, without success, dried gluten, and hartshorn shavings.

The yolk of egg, wax, butter, grease, and suet, burned like oil, but with a greater cracking: wool, and a piece of rabbits' skin with the down, and thoroughly impregnated with super-oxygenated muriate of pot-ash, took fire and burned till they were entirely consumed.

Amongst the experiments which afforded some remarkable singularities, we ought to mention, that we could never inflame the fulminating powder; although decomposition, as well as an abundant disengagement of gas and heat, took place. Three other mixtures with metallic bases, likewise surprised us by their alarming explosion, their rapid inflammation, and their powerful effect in fire arms, exploding like powder by a spark from the flint. M. Robert undoubtedly tried them, but he makes no observation on the subject: in this respect we shall follow his example, and make but two remarks. Fire-arms are much oxydated, and destroyed in a short time

by

by these mixtures, the preparation of which is more expensive and more difficult than that of gun-powder; we do not think them capable of being granulated. Their inflammable quality would render it too dangerous to remove or to use them, since shaking or friction would produce their explosion. We shall, therefore, not mention their names, as malevolence too frequently abuses the dangerous secrets revealed by chemists. The public security makes it our duty to be silent, and not to afford a fresh resource to the cruel art of destroying mankind.

Extract of a Memoir, by M. Ekeberg, *on some Properties of Yttria compared with those of Glucine, and on two Substances, in which he has found a new Metal combined in the one with Yttria and Iron, and in the other with Iron and Manganese.*

From the Annales de Chimie.

In the first part of his memoir M. Ekeberg treats of the comparison of the properties of yttria with those of glucine; whence it results, that the first of these earths is insoluble in caustic alkalis, and the second, on the contrary, is easily dissolved in them; which he asserts does not agree with what Klaproth and Vauquelin have said on the subject. Notwithstanding we find in the memoir of the latter (Annales de Chimie, vol. XXXVI. p. 135), that yttria is not perceptibly soluble in alkalis; in which respect it differs from alumine and glucine.

One of the characters, which M. Ekeberg considers as the most proper to distinguish yttria from glucine, is that of

of being precipitated from solutions by prussiate of potash, whilst on the contrary glucine is not. Vauquelin has likewise made the same remark in the memoir alluded to above.

The Swedish chemist has discovered that glucine is precipitated by solutions of amber, but that they do not produce the same effect on yttria: this is a new fact which M. Ekeberg has added to our still very imperfect acquaintance with these two earths.

The specific gravity appears likewise to be a very good distinction between the two substances when equally calcined. According to M. Ekeberg, that of yttria is 4,842, whilst that of glucine is only 2,967.

M. Vauquelin had likewise noticed this difference in weight: he was so struck with it, that since the publication of his memoir, suspecting that yttria might be a metallic oxyd, he heated some at a fierce fire in pulverized charcoal. He however obtained no metal, but only a half-melted and extremely hard mass; the weight of which was about five times greater than that of water.

Upon instituting a new analysis of the gadolinite, the mineral which contains yttria, M. Ekeberg found 4,5 of glucine *per cent.* which neither Klaproth nor Vauquelin perceived. Yet, from the characters which he discovered in this earth, there is no reason to doubt of its being the real glucine.

M. Ekeberg, according to Mr. Klaproth's method, separates the iron from the yttria by means of solutions of amber, which precipitate the iron and not the yttria, when either the one or the other is dissolved in an acid; but he remarks, that in order to produce this effect, it is necessary for the iron to be perfectly oxydated: otherwise there remains a part which is not precipitated.

From

From the last operations of M. Ekeberg it results, that the gadolinite contains in 100 parts

Yttria	55,5
Silica	23,0
Glucine	4,5
Oxyd of iron	16,5
Loss	0,5 only.

He makes no mention of oxyd of manganese, although he might ascertain its presence in the stone. He has not hitherto discovered the smallest trace of lime in the gadolinite, whence it appears that what Vauquelin found was only accidental, and that the specimens examined by M. Ekeberg contained none. But it is surprising that M. Ekeberg found only 0,5 loss, whilst Vauquelin invariably found it from 1,0 to 1,2. This difference is truly remarkable and extraordinary: can it arise from the difference of the stone, or of their method of operation?

In analysing other specimens of gadolinite which were given him by M. Geyer, M. Ekeberg discovered in them a metallic substance, combined in some with oxyd of iron and manganese, and in others with yttria and iron. These minerals were from the parish of Kimist, in Finland. He calls the first tantalite, and the second yttrotantalus, because the new metal they contain does not unite with acids.

The tantalite has been known in the cabinet of the mineralogist ever since the year 1746, by the name of oxydated tin ore. The mountain where it is found is formed of white quartz, mixed with mica, and intersected by veins of red feldspar, which likewise form the bed of the mineral. The pieces of tantalite are commonly in crystals as large as a nut, having the appearance of oxydated tin; their figure is nearly that of a regular octaedron. Their surface is smooth, black, and sparkling;

their fracture compact and metallic, with shades of blue and grey in some specimens; when reduced to powder, the latter is of a brownish-grey. They produce very bright sparks with steel, are not attracted by the load-stone, and their specific gravity is 7,953.

The yttrotantalus is found in the same place and bed as the gadolinite; it is always bedded in pure feldspar, of which the quarry of Ytterby principally consists. Quartz and mica may likewise be observed there; but those substances are isolated, and do not form a real granite. The feldspar is vertically intersected by veins of mica: and there M. Ekeberg advises the gadolinite and the yttratantalus to be sought.

The gadolinite is, in general, attached by one of its sides to a white, silvery mica, and enveloped in feldspar on the other sides.

The yttrotantalus is rarely found adhering to the mica; it is enclosed in the form of small globulous bodies in veins of feldspar, intersected by black mica. The largest pieces of yttrotantalus seen by M. Ekeberg, were nearly of the size of a nut. The fracture of this substance is granulated, of a metallic grey colour, it is not very hard, may be scraped with a knife, but with some difficulty; it is not subject to magnetic attraction; its specific gravity is 5,130, but as it always retains some particles of feldspar, it must, when pure, be rather heavier.

The following are the principal properties of the new metal discovered by M. Ekeberg: 1. It is insoluble in acids, in whatever state it is taken, and whatever means are employed; 2, alkalis attack and dissolve a considerable portion of it, which may afterwards be precipitated by acids; 3, the oxyd of this metal is white, and is never discoloured by fire; 4, its specific gravity, after being heated to a red-heat, is 6,500.; 5, it melts in phosphate

of

of soda and borax, without communicating any colour to them; 6, oxyd of tantalus put over the fire with pulverized charcoal, dissolves, and forms a mass; it has then a metallic appearance, the fracture is of a shining, blackish, grey, colour; 7. acids oxydate and reduce it to a white powder, as it was before. The metallic brilliancy which this substance acquires by its contact with charcoal, and by the aid of heat, and likewise its specific gravity, induce M. Ekeberg to class it among metals. He has ascertained that this metal resembles none of those with which we are already acquainted; the only metals to which he has found it bear any resemblance are tin, tungsten, and titan. The two former yield oxyds, soluble in a similar manner in fixed alkalis, and that resist the action of some acids; but the oxyd of tin is easible reducible, and furnishes a ductile metal: oxyd of tungsten dissolves in ammoniac, becomes yellow in acids, and communicates a blue colour to borax, which is not the case with oxyd of tantalus. The oxyd of titan is soluble in acids, after it has been divided by alkalis, and communicates a purple colour to borax.

The minerals which contain this metal, being probably very abundant in Sweden and Finland, chemists have reason to hope that M. Ekeberg will enter into a more minute investigation of the properties of this substance, that it may be recognized wherever it may exist, and be classed more easily under that division of metals to which it may appear to belong.

Eee 2 *Intelligence*

Intelligence relating to Arts, Manufactures, &c.

Agriculture.

THE Board of Agriculture has voted a gold medal to the Rev. R. B. Cluff, in the county of Denbigh, for irrigating the largest quantity of meadow-land on the best demonstrated principle; and also a silver medal to James Ferguson, M. P. of Aberdeenshire, for a similar operation in improved agriculture.

Preservation of Corn.

To preserve rye, and secure it from insects and rats, it has been discovered that nothing more is necessary than not to winnow it after being thrashed, but to stow it in the granaries mixed with the chaff. In this state it will keep three or four years without experiencing the smallest alteration, and even without the necessity of being turned to preserve it from humidity and fermentation. Care must however be taken not to bring it into the barn till thoroughly dry. To prevent rats and mice from entering into the barn or granary, put some wild vine or hedge plant upon the heaps: the smell of this wood is so offensive to these animals that they will not approach it. The passage of moles may be prevented by placing pieces of the same shrub in their way. The experiment has not yet been made with other kinds of grain; but they may probably be preserved in the chaff with equal advantage.

New Varnish for Earthen-Ware.

A new varnish for earthen-ware has lately been discovered. To make it, white glass and soda in equal portions

tions must be very finely pulverized, carefully sifted, and well mixed. The mixture is then exposed to a strong heat till it is rendered very dry. It is afterwards put into vessels which have been already baked, is then melted, and the varnish is made. It may be applied in the same manner as that in common use. The advantage of it is that it is safe, and can have none of those poisonous effects which arise from the decomposition of the lead-varnish.

New Lamp.

Baron Edelerantz has presented to the Society for the Encouragement of Arts at Paris, the description of a new lamp, which he calls the *Static Lamp*; and in which, by means of mercury and a weight, the oil is made at pleasure to ascend to, and remain at, any required height.

The same ingenious gentleman has likewise presented to the Society a memoir on improvements in apparatus for distilling on a large scale.

Spring of Petroleum.

A very rich and abundant spring of petroleum or naptha was a few months ago discovered at Amiano, a village in the state of Parma, on the Ligurian confines. The Ligurian government commissioned a learned chemist to analyse it, and it is now employed without mixture of any kind in lighting the city of Genoa. It gives an equal quantity of light at one-fourth of the expense of the latter, the pound of petroleum costing only two Genoese soldi. It is extremely limpid, of the colour of white wine, has a very strong pungent smell, but less empyreumatic than that of common or brown petroleum. Its specific gravity is to that of water as 83 to 100, and to that of olive oil as 91 to 100.

Cultivation of Hops in Russia.

The Emperor of Russia, wishing to encourage the establishment of English breweries in his dominions, has lately made a grant of lands to M. Potapow for the cultivation of hops. He has for that purpose chosen a situation in the government of Moscow.

Galvanism.

Some curious Galvanic experiments were lately made by Professor Aldini, in Dr. Pearson's lecture-rooms. They were far more interesting and satisfactory than any we have yet noticed on animals, owing to the pains taken to procure the fittest subjects for the operations.

Among other important facts, it was decisively shown,

1. That a vital attraction subsists between a nerve and muscle: for the suspended sciatic nerves of a frog, after detaching the spine, being brought near the intercostal muscles of a dog, while the assistant who held the frog did, with his other hand, touch the muscles of the thigh of the dog (thus forming a circle); in this situation the nerves suspended approached, and came into contact with the muscle, as evidently as a silken thread is attracted by sealing-wax.

2. The heart of a rabbit was excited to action in a little time after the animal was killed; but vitality disappeared much sooner than in the other muscles: so that this organ is the *primum*, and not, as Harvey asserted, the *ultimum moriens*. The lungs, liver, and spleen, could not be excited to action, even immediately after the animal was killed.

3. The most important fact of all was that of exciting contractions by making a circle of nerves and muscles of different animals, without any metallic exciter or conductor.

4. The

4. The head of an ox, recently decapitated, exhibited astonishing effects: for, the tongue being drawn out by a hook fixed into it, on applying the exciters, in spite of the strength of the assistant the tongue was retracted, so as to detach itself, by tearing itself, from the hook: at the same time a loud noise issued from the mouth by the absorption of air, attended by violent contortions of the whole head and eyes.

Chemistry.

Seguin has discovered a new triple salt composed of sulphuric acid, soda, and ammoniac. This salt crystallizes regularly, is fixed in air, and decrepitates in fire; which at first produces a disengagement of ammoniac, and afterwards of acid sulphate of ammoniac: the residue is a neutral sulphate of soda.

Fourcroy has found that red oxyd of mercury, digested for eight or ten days with ammoniac, acquires the property of fulminating.

Guyton has proved that not only barytes but all salifiable bases, alkalino-argillaceous, or alkaline only, are precipitated by prussiates by means of double affinities.

List of Patents for Inventions, &c.

(Continued from Page 320.)

James Gayleard, of New Bond-street, Middlesex, Staymaker; for long-stays, short-stays, and corsetts, on an improved construction. Dated February 1, 1803.

Stephen Hooper, of Walworth, Surry; for machines, or machinery, upon improved principles, and methods of using the same, for the purpose of cleansing creeks, bars of harbours, and preventing bars from making. Dated February 5, 1803.

William

William Henry Clayfield, of the city of Bristol, Wine-merchant; for a method of reducing and extracting lead, and other metals, from a compound substance, commonly known by the name of Regulus. Dated February 10, 1803.

Timothy Cobb, of Banbury, Oxfordshire, Woollen-manufacturer; for improvements in the manufacturing a certain kind of piece-goods, called Shag, or Plush. Dated February 21, 1803.

Jonathan Woodhouse, of Ashby-de-la-Zouch, Leicestershire, Engineer; for a method of forming a cast-iron rail, or plate, which may be used in making iron-rail roads, or ways, for the working and running of waggons, carts, drays, and other carriages, on public and other roads; and also, a new method of fixing, fastening, and securing, such cast-iron rail, or plate, on such roads. Dated February 28, 1803.

Robert Kirkwood, of Edinburgh, Engraver, and Copper-plate Printer; for improvements on the copper-plate printing-press. Dated February 28, 1803.

Thomas Johnson, of Bradbury, Cheshire, Weaver; for a method of preparing, and dressing cotton warp. Dated February 28, 1803.

Robert Mason, of Cumberland-street, Portsea, Hampshire, Gentleman; for improvements on a common waggon, whereby the same may be separated, and used as two carts, which he denominates the "Patent Hampshire Waggon." Dated February 28, 1803.

Benjamin Haden, of the parish of Sedgley, Staffordshire, Bagging Weaver; for an improvement in the manufacture of bagging, for packing of nails, and other purposes. Dated February 28, 1803.

THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

NUMBER XII. SECOND SERIES. MAY 1, 1803.

Specification of the Patent granted to THOMAS DAWSON, *of James-street, Long Acre, in the Parish of St. Martin in the Fields, in the County of Middlesex, Tin Plate-worker; for a Lamp or Lanthorn upon an improved Construction, which may be used with or without a Reflector, for the Convenience of Travelling-Carriages, and other useful Purposes.* Dated November 25, 1802.

With a Plate.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said Thomas Dawson do hereby declare that my said invention is described in the drawing and description thereof hereunto annexed. In witness whereof, &c.

DESCRIPTION of the DRAWINGS.

(See Plate XVI.)

Fig. 1 represents a circular lamp or lanthorn, made to fit into, and turn half round, in Figs. 2 and 3, and when

united or joined by solder or otherwise, forming a case, blind, or shade, for Fig. 1, for shading or darkening the light when required. A, is a small bolt or pin, made to pull up and push down, and to bolt into tube B, for the purpose of fastening door C when shut. D, is a ring, knob, &c. by which the lamp or lanthorn is turned when put or placed in the blind or shade Figs. 2 and 3, for the purpose of shading the light and preserving the glass. Fig. 1, when put or placed in Figs. 2 and 3, is united or made fast thereto by a hasp, or other proper fastening, fixed or attached in the usual way to the top of the case. E, is a small tube or hole to receive the catch or contrivance A in Fig. 4, for the purpose of fastening or uniting Fig. 1 to Fig. 2. In this case a common barrel is used therewith, for the convenience of turning the lamp or lanthorn round by the barrel in the case, shade, or blind.

Fig. 2, represents part of a case, shade, or blind, which may be either united to Fig. 3, or to a common barrel, as before described. Fig. 2 may also be made to turn round on the outside of the circular lamp or lanthorn if required; in that case the lamp or lanthorn must be attached or fixed to the carriage in the usual way, and an aperture or opening made in a case, blind, or shade, of sufficient length and width to admit the fastening of the lamp or lanthorn, so that the case may freely turn round backwards and forwards when the lamp or lanthorn is wanted to be darkened.

Fig. 4 represents the bottom of Fig. 2, with the addition of A, a catch or contrivance for uniting the same to Fig. 1, as before described.

Fig. 5 represents a square lamp, made nearly in the usual way; the door may be either made to open or shut as Fig. 1, or let down by a hinge placed or fixed at the

the bottom thereof, and fastened at the top by a bolt or pin to a tube adjoining to the door.

Fig. 6 represents a square case, shade, or blind, made to receive Fig. 5. When Fig. 5, placed in Fig. 6, is wanted to be shaded or darkened, it must be taken out and reversed with the glass next the back part of the case, shade, or blind, and *vice versâ* when light is again wanted.

Fig. 7 represents the rim or top of Fig. 6. A, A, are hasps, or other fastenings, for uniting or fastening the lamp or lanthorn to Fig. 6.

Thus have I given what I conceive to be a plain description of two of the most common-formed lamps or lanthorns in use, which will be sufficient for any workman of common abilities not only to make the same, but every other description of lamps or lanthorns to which the principle of my invention can be applied; such as ovals, oval circulars, octagons, sextagons, globular triangulers and Italian, (or round fronts and square sides,) which differ only from the above-described lamps or lanthorns in form or shape, the sole application of my principle therefore to which, as well as to all other lamps or lanthorns to which my invention can be applied, I claim as constituting my invention. The case is so constructed as to act as a shade or blind to circular, square, and other shaped carriage, or other lamps or lanthorns, for the purpose of shading or darkening the light when required, and preserving the glass from being broken; and if any accident should happen to the carriage, that the same may be taken out of their cases, &c. and used as hand lanthorns, and at pleasure replaced again.

In witness whereof, &c.

Specification of the Patent granted to WILLIAM DOBSON, *of the Strand, in the City of Westminster, Hardware-man; for certain Methods, by means of Machinery, never before applied for that Purpose, of chasing away Flies, and venomous Insects, calculated to promote the free Circulation of Air in Rooms, and to disperse the offensive Effluvia and Steam arising from Meat, Viands, &c.*

Dated November 25, 1802. With a Plate.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said William Dobson do hereby describe and ascertain the nature of my said invention, (which I denominate the Zephyr,) as follows; that is to say: In describing the form of this machine, I shall endeavour to avoid, as much as possible, the introduction of technical terms, using only such as are most universally understood.

The zephyr consists of the following parts, *viz.* the pillar marked *a a a*, (Fig. 1, Plate XVI.) at the top of which is a globe, vase, urn, or flat circular box, marked *b*, for containing the movements, which are wound up by a key at the hole *c*, the arms on which the sails are drawn *d d d*, the whole of which is supported by a moveable pedestal *e*. The pillar consists of cylindrical tubes, of different diameters, the smallest of which is inserted, and slides into the larger, like those of a telescope, by which means the sails may be so altered as to act either above the heads or before the faces of the company, as may be most agreeable, so that the pillar is fixed or draws out, screws out or winds up, of one piece or many, plain or ornamented. The urn or box at the top of the pillar contains the power which gives motion to the machine; it consists of the strongest and simplest clock, jack, and watch work, that can be used. There are

Fig. 2.

Fig. 4.

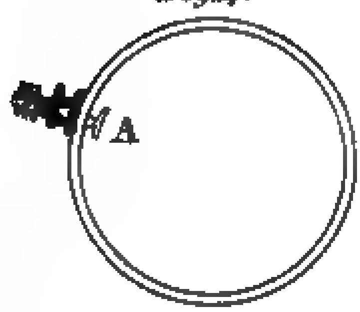

Fig. 3.

Fig. 7.

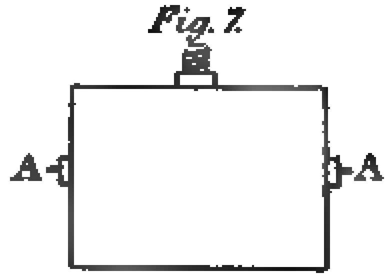

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Fig. 1.

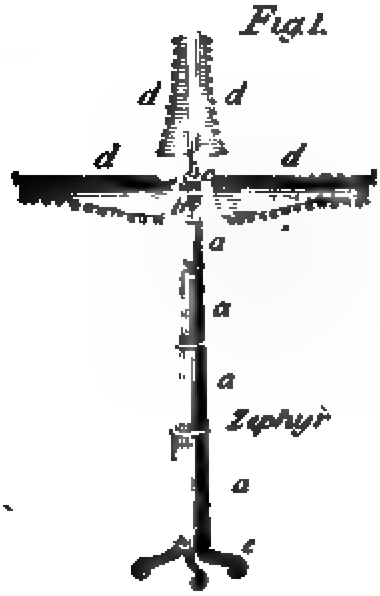
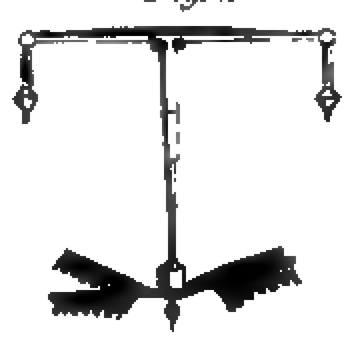


Fig. 2.



are various kinds of these machines, which variety necessarily demands, that the powers of them should differ according to the effect required of them, and agreeably to the nature of their situations. The arms on which the sails are drawn consists of tubes similar to those which form the pillar, fixed to a certain length, or not; they are made to move horizontally, or any other way: the arm is jointed at the end, that the sails may be lifted up out of the way, or to increase the velocity of the machine. The larger machines have a screw on each of the arms, to place them at any elevation; and spring receivers, to keep them up securely when not wanted down. The sails are made of almost every material, and almost every shape; among those which answer best, are silks, lawns, persians, crapes, gauzes, and nettings; to which might be added a variety of ornamental fringes, which would not only add to the beauty of their appearance, but in many instances to their usefulness. Nettings are perhaps the most appropriate, to chase away winged insects in general.

Having thus described the machine, it may be requisite to point out, briefly, the mode of its operation. The machine being wound up, and placed in its intended situation, its sails move in a horizontal direction, (unless otherwise required,) and propel the air in a circular current commensurate (in the first instance) to its own size. As the sails revolve, the air first circulated stimulates and even forces the circumjacent air to partake of its motion, which likewise operating in a similar manner, in a few seconds circulates all the air in the room, the outer part of the circulation being repeatedly driven to the sides of the room, it rushes along in the direction of the sails till it is forced out at the chimney, the usual outlet of air.

Fig. 2, is a zephyr, suspended from the cieling.

In witness whereof, &c.

Specification

Specification of the Patent granted to WILLIAM PLEES, *of Chelsea, in the County of Middlesex, Gentleman; for certain Methods of manufacturing Paper for various Purposes, and of applying one of the said Methods to Purposes for which Paper hath never before been used.*

Dated September 27, 1802.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said William Plees do hereby describe and specify my said invention, as follows. My first invention is that of a paper manufactured of any of the various substances already known to be veined, clouded, mottled, or speckled in different colours, by adding paper-stuff, paper-shavings, rags of linen, cotton, or silk, straw, hay, chaff, tan, tobacco, snuff, bark, bran, bronze, spangles, frosts, foils, or any other substances capable of being made to bed, sufficiently, into the stuff which forms the ground. These veins, clouds, mottles, or speckles, to be mixed with the stuff, so as to form one general mass previous to the dipping; and either cut or torn by hand, by the engine, or by any other machine more suitable, or as most convenient; or else to be sprinkled or poured over the mould before dipping; or over the sheet before or after couching; or received on the mould by repeated dippings before couching; or by couching two or more deliveries on each other. My invention being that of making paper of various colours in the same sheet, by adding substances of different tints, and which the several methods above described will attain in a variety of ways according to fancy. My second invention is for applying the above, and also any other description of paper, capable of being rendered elastic, to the purposes of leather,

ther, by tanning, currying, or dressing them, in any of, or all the various methods already known for finishing leather, from the hide or skin. The methods I have principally used, are by taking wool or woollen rags, either alone or mixed with those of linen, cotton, hemp, or flax, or what is generally called junk, the principal properties intended to be given being those of strength and elasticity. In witness whereof, &c.

Specification of the Patent granted to WILLIAM-HENRY CLAYFILED, *of the City of Bristol, Wine-merchant; for a Method of reducing and extracting Lead and other Metals from a compound Substance, commonly known by the Name of Regulus or Regule, and at present obtained as the Residue or Refuse of certain Ores at the Lead-Furnaces, and also obtained in other Works or Manufactories; which said Regulus appears to consist chiefly of the Oxides of Lead and Arsenic, and also from Ores or native Minerals, of nearly the same Composition.*

Dated February 10, 1803.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said William-Henry Clayfield do hereby declare, that my said invention is described in manner following; that is to say: Instead of the ordinary treatment to which the ores of lead are most commonly subjected, (that is to say, roasting at a low red heat, with or without the addition of coal and lime, and subsequent fusion by a stronger heat, followed by drying up with lime and coal, and a succeeding fusion,) I adopt the following process.

I cover

I cover the bottom of the furnace with a considerably greater proportion of lime than would be required for lead ores, and upon the said lime I dispose the regulus, and immediately proceed to fusion by a strong heat. It is not absolutely necessary to use lime in this first fusion, though it is most advantageous so to do. To the fused mass I then add a much larger proportion of coal and of lime than is commonly used in drying up or checking the fusion of lead ore. By the last-mentioned addition, a considerable quantity of the lead is separated in the metallic state, and runs to the bottom of the furnace, where it is to be immediately tapped out; and any portion of the fused regulus which may have passed along with it, is to be taken up and returned into the furnace. I then add more coal and lime, and rake up the remainder of the charge towards the flame, in order, by a strong heat, to separate still more of the lead; and I repeat this process of adding lime and coal, and raking up, during the remainder of ten or twelve hours, reckoned from the commencement of the whole operation; at the end of which period the mass will be found in a state much less capable of fusion than before. I then rake out the residue, and expose the same to a still stronger heat, in a furnace of any other construction, in order to extract the remainder of the lead, and other metals, by the addition of combustible and other substances, according to the well-known practices of chemists.

Or otherwise, in case the furnace first used be capable of raising and supporting a sufficient degree of heat, then the entire course of operation or treatment of the regulus, from the first to the last part thereof, may be conducted and performed in the said last-mentioned furnace.

And I do farther declare, that in the cases where coal is herein-before directed to be used, the effect of reducing the

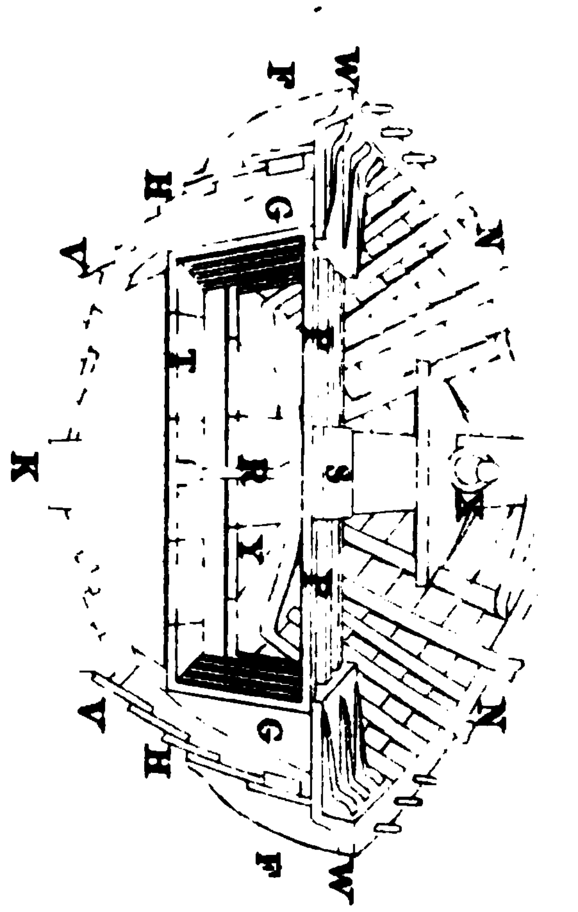


Fig. 2.

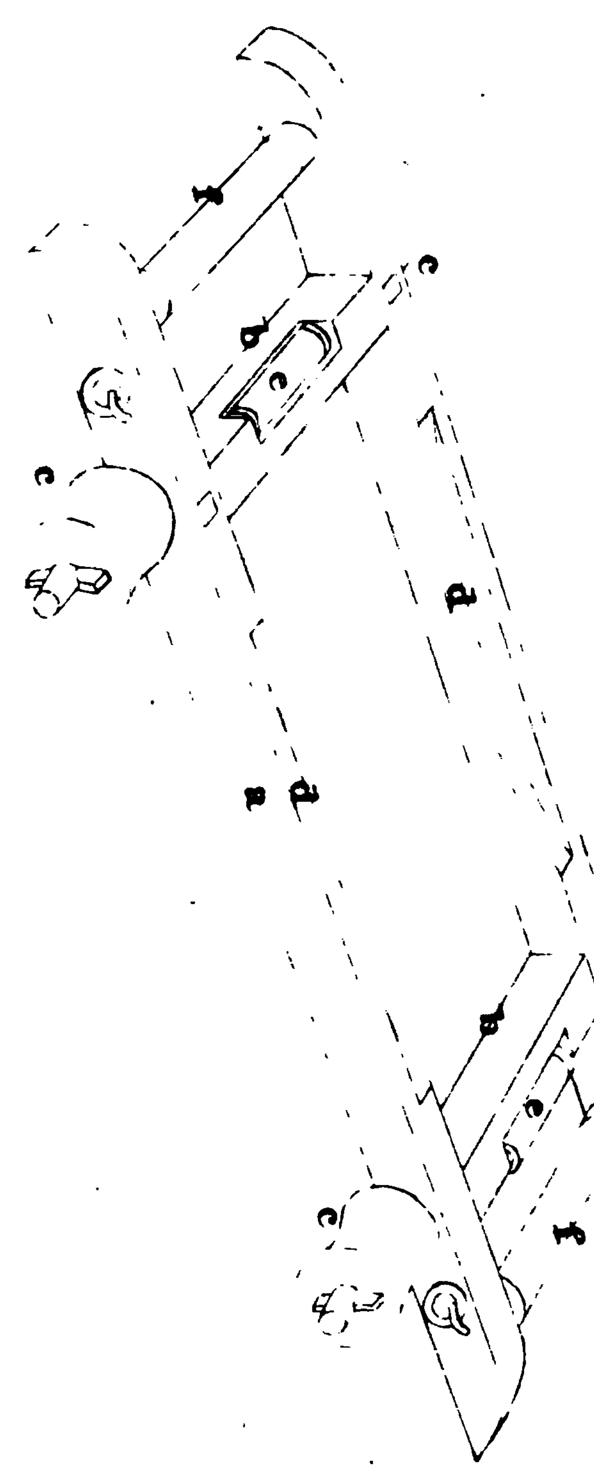


Fig. 3.

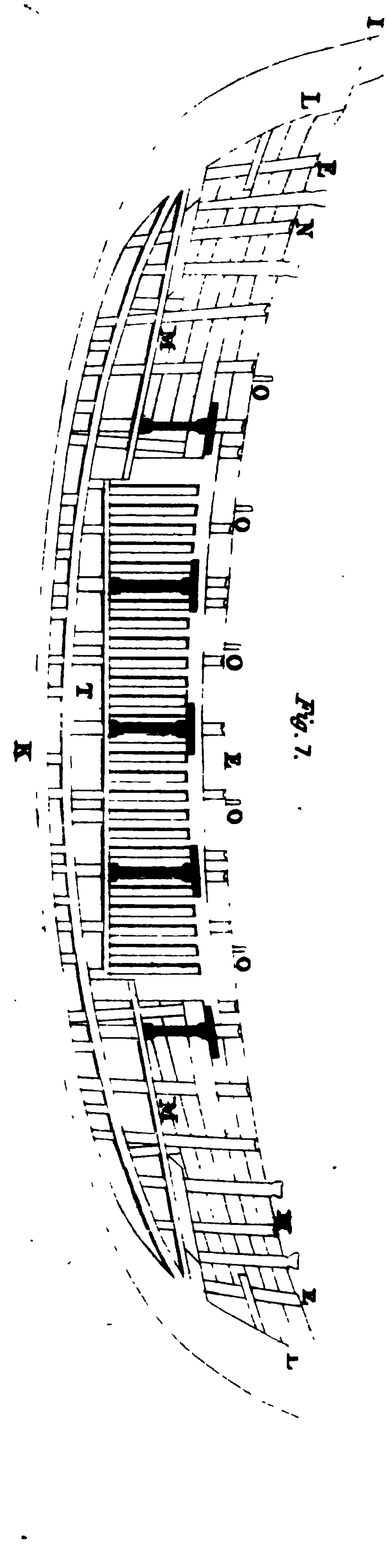


Fig. 7.

the metal may be produced by various other well-known combustible substances, in like manner as by pit-coal, which is there meant and preferred for its cheapness, and other well-known properties.

And farther, that in some cases, such as the treatment of ores, similar in their nature to the said regulus, it will be found adviseable to add a portion of coal in the first fusion; but that this variation, and other slight changes in my said method, as herein-before described, (with regard to the quantities of materials, and to the time of continuing the several operations, and to the management of the fire, and to various other matters and things,) do not need to be pointed out and explained, because the same may and will be carried into effect, without farther instruction, by any person of competent skill to be trusted with the management of a work of this nature. In witness whereof, &c.

Description of a Boat, of a peculiar Construction, named a Life-Boat. Invented by Mr. HENRY GREATHEAD, *of South Shields.*

With a Plate.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

The Gold Medal and Fifty Guineas were voted to Mr. GREATHEAD *for this Invention.*

THE following particular account of the construction of the life-boat, transmitted to the Society by Mr. Thomas Hinderwell, explains upon what principle it is built, so as to render it superior to any other form of boat for

the dangerous enterprizes for which it was intended, and has been used.

The length is thirty feet; the breadth ten feet; the depth, from the top of the gunwale to the lower part of the keel in midships, three feet three inches; from the gunwale to the platform *(within)* two feet four inches; from the top of the stems (both ends being similar) to the horizontal line of the bottom of the keel, five feet nine inches. The keel is a plank of three inches thick, of a proportionate breadth in midships, narrowing gradually towards the ends, to the breadth of the stems at the bottom, and forming a great convexity downwards. The stems are segments of a circle, with considerable *rakes.* The bottom section, to the floor-heads, is a curve fore and aft, with the sweep of the keel. The floor-timber has a small *rise* curving from the keel to the floor-heads. A bilge plank is wrought in on each side next the floor-heads with a double *rabbet* or groove, of a similar thickness with the keel; and, on the outside of this, are fixed two bilge-trees, corresponding nearly with the level of the keel. The ends of the bottom section form that fine kind of entrance observable in the lower part of the bow of the fishing-boat, called a *Coble,* much used in the north. From this part to the top of the stem, it is more elliptical, forming a considerable projection. The sides, from the the floor-heads to the top of the gunwale, flanch off on each side, in proportion to about half the breadth of the floor. The breadth is continued far forward towards the ends, leaving a sufficient length of straight side at the top. The sheer is regular along the straight side, and more elevated towards the ends. The gunwale, fixed on the outside, is three inches thick.—The sides, from the under part of the gunwale, along the whole length of the regular sheer, extending twenty-one feet six inches,

are

are cased with *layers* of cork, to the depth of sixteen inches downward; and the thickness of this casing of cork being four inches, it projects at the top a little without the gunwale. The cork, on the outside, is secured with thin plates or slips of copper, and the boat is fastened with copper nails. The *thwarts*, or seats, are five in number, *double banked*, consequently the boat may be rowed with ten * oars. The *thwarts* are firmly stanchioned. The side oars are short †, with iron tholes and rope grommets, so that the rower can pull either way. The boat is steered with an oar at each end; and the steering-oar is one third longer than the rowing-oar. The platform placed at the bottom, within the boat, is horizontal, the length of the midships, and elevated at the ends, for the convenience of the steersman, to give him a greater power with the oar. The internal part of the boat next the sides, from the under part of the *thwarts* down to the platform, is cased with cork; the whole quantity of which, affixed to the life-boat, is nearly seven hundred weight. The cork indisputably contributes much to the buoyancy of the boat, is a good defence in going along-side a vessel, and is of principal use in keeping the boat in an erect position in the sea, or rather of giving her a very lively and quick disposition to recover from any sudden *cant* or *lurch* which she may receive from the stroke of a heavy wave. But, exclusive of the cork, the admirable construction of this boat gives it a decided pre-eminence. The ends being similar, the boat can be rowed either way; and this peculiarity of form alleviates her in rising over the waves. The curva-

* Five of the benches are only used, the boat being generally rowed with ten oars.

† The short oar is more manageable in a high sea than the long oar, and its stroke is more certain.

ture of the keel and bottom facilitates her movement in turning, and contributes to the ease of the steerage, as a single stroke of the steering-oar has an immediate effect, the boat moving as it were upon a centre. The fine entrance below is of use in dividing the waves, when rowing against them; and, combined with the convexity of the bottom, and the elleptical form of the stem, admits her to rise with wonderful buoyancy in high sea, and to launch forward with rapidity, without shipping any water, when a common boat would be in danger of being filled. The *flanching*, or spreading form of the boat, from the floor-heads to the gunwhale, gives her a considerable *bearing*; and the continuation of the breadth, well forward, is a great support to her in the sea; and it has been found by experience, that boats of this construction are the best sea-boats for rowing against turbulent waves. The internal shallowness of the boat, from the gunwale down to the platform, the convexity of the form, and the bulk of cork within, leave a very diminished space for the water to occupy; so that the life-boat, when filled with water, contains a considerably less quantity than the common boat, and is in no danger either of sinking or overturning. It may be presumed, by some, that, in cases of high wind, agitated sea, and broken waves, a boat of such a bulk could not prevail against them by the force of the oars; but the life-boat, from her peculiar form, may be rowed *a-head*, when the attempt in other boats would fail. Boats of the common form, adapted for speed, are of course put in motion with a small power; but, for want of buoyancy and bearing, are over-run by the waves and sunk, when impelled against them: and boats, constructed for burthen, meet with too much resistance from the wind and sea, when opposed to them, and cannot in such cases

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be rowed from the shore to a ship in distress. An idea has been entertained, that the superior advantages of the life-boat are to be ascribed solely to the quantity of cork affixed. But this is a very erroneous opinion; and, I trust, has been amply refuted by the preceding observations on the supereminent construction of this boat. It must be admitted, that the application of cork to common boats would add to their buoyancy and security; and it might be a useful expedient, if there were a quantity of cork on board of ships, to prepare the boats with, in cases of shipwreck, as it might be expeditiously done, in a temporary way, by means of *clamps*, or some other contrivance. The application of cork to some of the boats of his Majesty's ships * might be worthy of consideration; more particularly as an experiment might be made at a little expense, and without inconvenience to the boats; or may prevent pleasure-boats from upsetting or sinking.

The life-boat is kept in a boat-house, and placed upon four low wheels, ready to be moved at a moment's notice. These wheels are convenient in conveying the boat along the shore to the sea; but if she had to travel upon them on a rough road, her frame would be exceedingly shaken. Besides, it has been found difficult and troublesome to replace her upon these wheels, on her return from sea. Another plan has, therefore, been adopted. Two wheels, of nine feet diameter, with a moveable arched axis, and a pole fixed thereto for a lever, have been constructed. The boat is suspended near her centre, between the wheels, under the *axis*; toward each extremity of *which* is an iron pin, with a chain attached. When the pole is elevated perpendicularly, the upper

* The Launches.

part

part of the axis becomes depressed, and the chains being hooked to *eye-bolts*, on the inside of the boat, she is raised with the utmost facility, by means of the pole, which is then fastened down to the stem of the boat.

The Scarborough boat is under the direction of a committee. Twenty-four fishermen, composing *two crews* *, are alternately employed to navigate her. A reward, in cases of shipwreck, is paid by the committee to each man actually engaged in the assistance; and it is expected that the vessel receiving assistance should contribute to defray this expense. None have hitherto refused.

It is of importance, that the command of the boat should be entrusted to some steady, experienced person, who is acquainted with the direction of the tides or currents, as much skill may be required in rising *them* to the most advantage, in going to a ship in distress. It should also be recommended, to keep the *head* of the boat to the *sea*, as much as circumstances will admit; and to give her an accelerated velocity to meet the wave. Much caution is necessary in approaching a wreck, on account of the strong reflux of the waves, which is sometimes attended with great danger. In a general way, it is safest to go on the *lee* quarter; but this depends upon the position of the vessel; and the master of the boat should exercise his skill in placing her in the most convenient situation. The boatmen should practise themselves in the use of the boat, that they may be the better acquainted with her movements; and they should at all times be strictly obedient to the directions of the person who is appointed to the command.

* Two crews are appointed, that there may be a sufficient number ready in case of any absence.

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The great ingenuity which has been displayed in the construction of the life-boat, leaves scarcely any room for improvement; but some have supposed, that a boat of twenty-five feet in length, with a proportionate breadth, would answer every purpose of a larger one. A boat of these dimensions would certainly be lighter, and less expensive; but whether she would be equally *safe* and *steady* in a high sea I cannot take upon myself to determine.

Mr. Greathead, of South Shields, the inventor, undertakes to build these boats, and to convey them to any port in the kingdom. He is a worthy man, in whom a confidence may be reposed, and will build upon moderate terms of profit.

Mr. Greathead gives the following general Instructions for the Management of the Life-Boat at Sea; and a brief Account of the Method practised at Lowestoffe, in Suffolk, of removing the Boat belonging to that Place to and from the Sea.

The boats in general of this description are painted white on the outside, this colour more immediately engaging the eye of the spectator at her rising from the hollow of the sea, than any other. The bottom of the boat is at first varnished (which will take paint afterwards), for the more minute inspection of purchasers. The oars she is equipped with are made of fir, of the best quality, having found by experience that a rove-ash oar that will dress clean and light, is too pliant among the breakers; and when made strong and heavy, from rowing double banked, the purchase being short, sooner exhausts the rower, which makes the fir oar, when made stiff, preferable.

In the management of the boat, she requires twelve men to work her; that is, five men on each side, rowing double banked,

banked, with an oar slung over an iron thole, with a grommet (as provided) so as to enable the rower to pull either way; and one man, at each end, to steer her, and to be ready at the opposite end to take the steer-oar when wanted. As, from the construction of the boat, she is always in a position to be rowed either way, without turning the boat, when manned, the person who steers her should be well acquainted with the course of the tides, in order to take every possible advantage: the best method, if the direction will admit of it, is to head the sea. The steersman should keep his eye fixed upon the wave or breaker, and encourage the rowers to give way, as the boat rises to it; being then aided by the force of the oars, she launches over it with vast rapidity, without shipping any water. It is necessary to observe, that there is often a strong reflux of sea, occasioned by the stranded wrecks, which requires both dispatch and care in the people employed, that the boat be not damaged. When the wreck is reached, if the wind blows to the land, the boat will come in shore without any other effort than steering.

I would strongly recommend practising the boat, by which means, with experience, the danger will appear less, from the confidence people will have in her from repeated trials.

The life-boat may be launched from any beach, when wanted, with as much ease as any other boat, by proper assistance. The distance from the boat-house, at Lowetoffe, to the shore, is one hundred yards, and the boats' crew can run her down in ten minutes. When the sea does not tumble in upon the beach very much, the boat may be easily launched by laying the ways as far as possible in the water, and hauling the carriage from under her.

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When there is a great sea on the beach, the boat must be launched from the carriage before she comes to the surf, on planks laid across, as other boats are launched; the people standing on the ends to prevent the sea moving them; then, with the assistance of the anchor and cable, (which should be laid out at sea for the purpose,) the boat's crew can draw her over the highest sea.

Upon the boat returning to the shore, two double blocks are provided; and, having a short strop fixed in the hole, in the end of the boat next the sea, the boat is easily drawn upon the carriage.

References to Plate XVII.

Fig. 1, a longitudinal section of the life-boat. E E E, the sheer or curve of the boat. I, I, the two stems or ends. K, the keel. L, L, the aprons, to strengthen the stems. M, M, the sheets, or places for passengers. N, N, timber-heads, or boat-fastenings. O, O, O, O, O, the tholes on which the oars are slung by grommets. T, flooring under the rowers' feet.

Fig. 2, a cross section of the life-boat. F, F, the outside coatings of cork. G, G, the inside cork filling. H, H, the outside planks of the boat. I, one of the stems of the boat. K, the keel. N, N, the timber heads. P, P, the thwarts, or rowers' seats. R, one of the stanchions under the thwarts, each being thus firmly supported. S, a section of the gang-board, which crosses the thwarts, and forms the passage from one end of the boat to the other. T, the floor-heads, or platform for the rowers' feet. V, V, the two bilge pieces, nearly level with the keel. W, W, the gunwales. X, a ring-bolt for the head-fast, there being another also at the other end. Y, platform for the steersman.

Fig. 3, a truck or carriage, with four wheels, to convey the boat to and from the sea. *a*, an oblong frame of wood, consisting of two long pieces, hollowed a little to admit the body of the boat, and secured by the cross pieces *b*, *b*. *c,c,c,c*, four low wheels, each sunk or hollowed in the middle, to run better upon a rail-way or timber-road. *d*, *d*, two indents made in the side-timbers, that the bottom of the boat may lie firm therein. *e*, *e*, two small rollers, moveable in the cross timbers, for the keel of the boat to slide upon. *f*,*f*, two long rollers, one at each end of the frame, to assist in raising the boat upon or sliding it off the truck or carriage.

I shall have a complete model of my life-boat, on the scale of one inch to a foot, ready to send to the Society in a little time; and it having been much desired that the life-boat might be brought into general use, for ships, (in which case it is a great object to have her to sail,) I have, in a model lately made, adopted the sliding keel, (an improvement of the Dutch lee-board,) with the addition of one of them at one end sliding angular, so as to correspond with the keel of the rudder, at any depth. This angular sliding keel is entirely new: I have shewn the improvement to several nautical men, who highly approve of it.

The keels and rudder are attached in such a manner, that she can be easily divested of them, when necessary, and will then be the exact form of the original life-boat. I should have sent you the model before this time; but the orders for life-boats have been so numerous, and so generally pressing, that I have not yet had time to execute it.

Since the award of the Society's bounty to Mr. Greathead, the sum of twelve hundred pounds has been voted to him by parliament for his life-boat.

He

He has also received other rewards on the same account from the Trinity-House, and Members at Lloyd's, which have been noticed in the public newspapers.

Particulars relative to the Construction of, and Benefits received from, sundry Life-Boats, built by Mr. Henry Greathead, *or under his Directions, in and since the Year* 1789.

Account of the South Shields Life-Boat.

From the declaration of Sir Cuthbert Heron, Bart. of South Shields, it appears, that when the Adventure was wrecked in 1789, on the Herd Sands, he offered a reward for any seamen to go off to save the men's lives, which was refused; and that the greatest part of the crew of the Adventurer perished within 300 yards of the shore, and in sight of a multitude of spectators. The gentlemen of South Shields immediately met, and offered a reward to any person who would give in a plan of a boat, which should be approved, for the preservation of men's lives. Mr. Greathead gave in a plan, which met with approbation; a committee was formed, and a subscription raised, for the building of a boat upon that plan. After it was built, it was with some difficulty that the sailors were induced to go off in her; but, in consequence of a reward offered, they went off, and brought the crew of a stranded vessel on shore. Since which time the boat has been readily manned, and no lives have been lost (except in the instances of the crews trusting to their own boats); and, in his opinion, if Mr. Greathead's boat had existed at the time of the wreck of the Adventure, the crew would have been saved.

From other accounts it appears, that in the year 1791 the crew of a brig, belonging to Sunderland, and laden

 from

from the westward, were preserved by this life-boat, the vessel at the same time breaking to pieces by the force of the sea.

On January 1st, 1795, the ship Parthenius, of Newcastle, was driven on the Herd Sand, and the life-boat went to her assistance, when the sea breaking over the ship as the boat was ranging along-side, the boat was so violently shaken that her bottom was actually hanging loose: under these circumstances she was three times off to the ship, without being affected by the water in her.

The ship Peggy being also on the Herd Sand, the life-boat went off, and brought the crew on shore, when the plug in her bottom had been accidently left out; though she filled with water in consequence, yet she effected the purpose in that situation.

In the latter part of the year 1796, a sloop belonging to Mr. Brymer, from Scotland, laden with bale goods, was wrecked on the Herd Sand; the crew and passengers were taken out by the life-boat; the vessel went to pieces at the time the boat was employed, the goods were scattered on the sand, and part of them lost.

In the same year, a vessel named the Countess of Errol, was driven on the Herd Sand, and the crew saved by the life-boat.

October 15, 1797, the sloop called Fruit of Friends, from Leith, coming to South Shields, was driven on the Herd Sand. One part of the passengers, in attempting to come on shore in the ship's boat, was unfortunately drowned; the other part was brought on shore safe by the life-boat.

The account of Captain William Carter, of Newcastle, states, that on the 28th November, 1797, the ship Planter, of London, was driven on shore near Tynemouth Bar, by the violence of a gale; the life-boat came out, and

and took fifteen persons from the ship, which the boat had scarcely quitted before the ship went to pieces; that, without the boat, they must all have inevitably perished, as the wreck came on shore soon after the life-boat. He conceived that no boat, of a common construction, could have given relief at that time. The ships Gateshead and Mary, of Newcastle, the Beaver, of North Shields, and a sloop, were in the same situation with the Planter. The crew of the Gateshead, nine in number, took to their own boat, which sunk, and seven of them were lost; the other two saved themselves, by ropes thrown from the Mary. After the life-boat had landed the crew of the Planter, she went off successively to the other vessels, and brought the whole of the crews safe to shore, together with the two persons who had escaped from the boat of the Gateshead.

Mr. Carter adds, that he has seen the life-boat go to the assistance of other vessels, at different times, and that she ever succeeded in bringing the crews on shore; that he had several times observed her to come on shore full of water, and always safe.

Account of the Northumberland Life-Boat.

The Northumberland life-boat, so called from being built at the expense of his Grace the Duke of Northumberland, and presented by him to North Shields, was first employed in November, 1798, when she went off to the relief of the sloop Edinburgh, of Kincardine, which was seen to go upon the Herd Sands, about a mile and a half from the shore. Ralph Hillery, one of the seamen who went out in the life-boat to her assistance, relates, that she was brought to an anchor before the life-boat got to her; that the ship continued to strike the ground so heavily, that she would not have held together ten minutes

nutes longer, had not the life-boat arrived; they made her cut her cable, and then took seven men out of her, and brought them on shore; that the sea was at that time so monstrously high, that no other boat whatever could have lived in it. He stated, that in the event of the life-boat filling with water, she would continue still upright, and would not founder, as boats of a common construction do; that he has seen her go off scores of times, and never saw her fail in bringing off such of the crews as staid by their ships.

It also saved (as appears from other accounts) the crew of the brig Clio, of Sunderland, when she struck upon the rocks, called the Black Middens, on the north side of the entrance of Tynemouth Haven.

October 25, 1799, the ship Quintillian, from St. Petersburgh, drove on the Herd Sand, from the force of the sea-wind at N. E. knocked her rudder off, and was much damaged; but the crew were brought on shore by the life-boat. The great utility of this life-boat is also confirmed by many other recent circumstances: one among which is that of the ship Sally, of Sunderland, which, in taking the harbour of Tynemouth, on December 25, 1801, at night, struck on the bar: the crew were brought on shore by the life-boat, but the ship was driven among the rocks.

On the 22d of January, 1802, in a heavy gale of wind, from the N. N. W. the ship Thomas and Alice, in attempting the harbour of South Shields, was driven on the Herd Sand: the Northumberland life-boat went to her assistance; took, as was supposed, all the people out, and pulled away from the ship to make the harbour, when they were waved to return by a man who had been below deck. On taking this man out they encountered a violent gust of wind, under the quarter of the ship; the ship at the

the same time drove among the breakers; and, entangling the boat with her, broke most of the oars on that side of the boat next the ship, and filled the boat with water. By the shock, several of the oars were knocked out of the hands of the rowers, and that of the steersman. In this situation, the steersman quickly replaced his oar from one of those left in the boat, and swept the boat before the sea, filled with water inside as high as the midship gunwale: the boat was steered in this situation before the wind and sea, a distance far exceeding a mile, and landed twenty-one men, including the boat's crew, without any accident but being wet.

Mr. Hinderwell, of Scarborough, communicated, in a Letter to Mr. Greathead, the following Account of the Scarborough Life-Boat.

The life-boat at Scarborough, which was built without the least deviation from the model and the plan which you sent here at my request, has even exceeded the most sanguine expectations; and I have now received experimental conviction of its great utility in cases of shipwreck, and of its perfect safety in the most agitated sea. Local prejudices will ever exist against novel inventions, however excellent may be the principles of their construction; and there were some, at this place, who disputed the performance of the life-boat, until a circumstance lately happened, which brought it to the test of experience, and removed every shadow of objection, even from the most prejudiced minds.

On Monday, the 2d of November, we were visited with a most tremendous storm from the eastward, and I scarcely ever remember seeing a more mountainous sea. The Aurora, of Newcastle, in approaching the harbour, was driven ashore to the southward; and, as she was in the

the most imminent danger, the life-boat was immediately launched to her assistance. The place where the ship lay was exposed to the whole force of the sea, and she was surrounded with broken water, which dashed over the decks with considerable violence. In such a perilous situation the life-boat adventured, and proceeded through the breach of the sea, rising on the summit of the waves, without shipping any water, except a little from the spray. On going upon the lee-quarter of the vessel, they were endangered by the main-boom, which had broken loose, and was driving about with great force. This compelled them to go alongside, and they instantly took out four of the crew; but the sea which broke over the decks having nearly filled the boat with water, they were induced to put off for a moment, when seeing three boys (the remainder of the crew) clinging to the rigging, and in danger of perishing, they immediately returned, and took them into the boat, and brought the whole to land in safety. By means of the life-boat, built from your plan, and the exertions of the boatmen, seven men and boys were thus saved to their country and their friends, and preserved from the inevitable destruction which otherwise awaited them. The boat was not in the least affected by the water which broke into her when alongside the vessel; and, indeed, the boatmen thought it rendered her more steady in the sea. I must also add, that it was the general opinion that no other boat of the common construction could have possibly performed this service; and the fishermen, though very adventurous, declared they would not have made the attempt in their own boats.

We have appointed a crew of fishermen to manage the boat, under the direction of the committee; and the men are so much satisfied with the performance of the boat, and

and so confident in her safety, that they are emboldened to adventure upon the most dangerous occasion.

By other accounts, furnished to the Society, it appears that the Scarborough life-boat, on the 21st of November, 1801, was the means of saving a sloop belonging to Sunderland, and her crew consisting of three men and boys: also the Experiment, of London, her cargo, and crew consisting of eight men and boys, when in a distressed and perilous situation, on the 22d of January last, which facts are attested by eleven owners of ships resident in Scarborough.

In the course of the last twelve years, several ships and vessels, which have not been included in the above accounts, have been driven on shore in bad weather, and got off again afterwards: the crews have been saved by being taken out by the life-boat, whereas, if they had remained on board, they must have perished, the sea making a passage over them.

Account of the Hindu Method of cultivating the Sugar-Cane, and manufacturing the Sugar and Jagary in the Rajahmundry District; interspersed with such Remarks as tend to point out the great Benefit that might be expected from increasing this Branch of Agriculture, and improving the Quality of Sugar.

By Dr. WILLIAM ROXBURGH.

From the ASIATIC ANNUAL REGISTER.

AT a period like the present, when the importation of East India sugar has become so much an object of importance to Great-Britain, in consequence of the present state of some of the best of the West-India sugar islands, every inquiry that may tend to open new sources, from

whence that wholesome commodity can be procured, at the cheapest rate, is of national importance.

I believe there are few districts in the company's extensive possessions where there will not be found large tracts of land fit for the culture of sugar cane; but I know, from experience, the introduction of a new branch of agriculture, amongst the natives, to be attended with infinite trouble; therefore, where we find a province or district, in which the culture of the cane and making of sugar has been in practice from time immemorial, there we may expect, without much exertion, to be able to increase the culture, and improve, if necessary, the quality.

In the northern provinces, as well as in Bengal, Cadapah, &c. large quantities of sugar and jagary are made; it is only in the Rajahmundry and Ganjam districts of these northern provinces where the cane is cultivated for making sugars. I will confine my observations to the first, where I have resided between ten and eleven years.

This branch of agriculture, in the above mentioned sircar, is chiefly carried on in the Peddapore and Pettapore, along the banks of the Elyseram river, which, though small, has a constant flow of water in it the whole year round, sufficiently large, not only to water the sugar plantations during the driest seasons, but also a great variety of other productions, such as paddy, ginger, turmerick, yams, chillies, &c. This stream of water, during the driest season, renders the lands adjoining to this river of more value, I presume, than almost any other in India, and particularly fit for the growth of sugar-cane.

By the bye, permit me to observe, that of all the parts of India that I have seen, this seems the best suited for the culture of the mulberry and rearing silk-worms, as well

well on account of the cheapness of labour, and the general abundance of provisions for the natives, as for the soil, climate, and situation.

But to return to the culture of sugar; in these two zimindaries from 350 to 700 vissums, or from 700 to 1400 acres of land (the vissum being two acres), are annually employed for the rearing sugar cane, more or less, according to the demand for sugar; for they could and would with pleasure, if they were certain of a market, grow and manufacture more than ten times the usual quantity; for it is very profitable, and there is abundance of very proper land: all they want is a certain market for their sugar.

Besides the above-mentioned, a third more may be made on the Delta of the Godavary.

From the same spot they do not attempt to rear a second crop oftener than every third or fourth year; the cane impoverishes it so much, that it must rest, or be employed during the two or three intermediate years, for the growth of such plants as are found to improve the soil, of which the Indian farmer is a perfect judge; they find the leguminous tribe the best for that purpose.

The method of cultivating the cane, and manufacturing the sugar by the natives hereabouts, is, like all other works, exceedingly simple; the whole apparatus, a few pair of buffaloes or bullocks excepted, does not amount to more than a few (15 or 20) pagodas; as many thousand pounds is generally, I believe, necessary to set out the West-India planter.

The soil that suits the cane best in this climate, is a rich vegetable earth, which, on exposure to the air, readily crumbles down into a very fine mould: it is also necessary for it to be of such a level, as allows of its being watered from the river, by simply damming it up,

(which almost the whole of the land adjoining to this river admits of,) and yet so high as to be easily drained during heavy rains. Such a soil, and in such a situation, having been well meliorated, by various crops of leguminous plants, or fallowing, for two or three years, is slightly manured, or has had for some time cattle pent in it; a favourite manure for the cane with the Hindu farmer, is the rotten straw of green and black pessaloo, (phaseolus nungo max). During the months of April and May, it is repeatedly ploughed with the common Hindu plough, which soon brings this loose rich soil into very excellent order. About the end of May and beginning of June, the rains generally set in, in frequent heavy showers; now is the time to plant the cane: but should the rain hold back, the prepared field is watered, flooded from the river, and while perfectly wet, like soft mud, whether from rain or the river, the cane is planted.

The method is most simple; labourers, with baskets of the cuttings with one or two joints each, arrange themselves along one side of the field; they walk side by side, in as straight a line as their eye and judgment enables them, dropping the sets at the distance of about eighteen inches asunder in the rows, and about four feet row from row; other labourers follow, and with the foot press the set about two inches into the soft mud-like soil; which, with a sweep or two with the sole of the foot, they most easily and readily cover; nothing more is done, if the weather is moderately showery, till the young shoots are some two or three inches high, the earth is then loosened for a few inches round them, with a small weeding iron, something like a carpenter's chisel; should the season prove dry, the field is occasionally watered from the river, continuing to weed, and to keep the ground loose round the stools. In August, two or

three

three months from the time of planting, small trenches are cut through the field at short distances, and so contrived as to serve to drain off the water, should the season prove too wet for the canes, which is often the case, and would render their juices weak and unprofitable; the farmer therefore never fails to have his field plentifully and judiciously intersected with drains, while the cane is small, and before the usual time for the violent rains: should the season prove too dry, these trenches serve to conduct the water from the river the more readily through the field, and also to drain off what does not soak into the earth in the course of a few hours; for they say, if water be permitted to remain in the field for a greater length of time, the cane would suffer by it, so that they reckon these drains indispensably necessary; and upon their being well contrived depends, in a great measure, their future hopes of profit. Immediately after the field is trenched, the canes are all propped; this is an operation I do not remember to have seen mentioned by any writer on this subject, and is probably peculiar to these parts. It is done as follows:

The canes are now about three feet high, and generally from three to six from each set that has taken root, and form what we may call the stool; the lower leaves of each cane are first carefully wrapped up round it, so as to cover it completely in every part; a small strong bamboo (or two), eight or ten feet long, is then stuck into the earth, in the middle of each stool, and the canes thereof tied to it; this secures them in an erect position, and gives the air free access round every part. As the canes advance in size, they continue wrapping them round with the lower leaves, as they begin to wither, and to tie them to the prop bamboos higher up, during which time, if the weather be wet, they keep the drains

open;

open; and if a drought prevails, they water them occasionally from the river, cleaning and loosening the ground every five or six weeks: tying the leaves so carefully round every part of the canes, they say, prevents them from cracking or splitting by the heat of the sun, helps to render the juice richer, and prevents their branching out round the sides: it is certain you never see a branchy cane here.

In January and February the canes are ready to cut, which is about nine months from the time of planting; of course I need not describe it. Their height, when standing in the field, will now be from eight to ten feet (foliage included), and the naked cane from an inch to an inch and a quarter in diameter.

A mill or two, or even more, according to the extent of the field, is erected, when wanted, in the open air, generally under the shade of large mangoe trees, of which there are great abundance hereabout; the mill is small, exceedingly simple, and at the same time efficacious. The juice, as fast as expressed, is received in common earthen pots, strained, and put into boilers, which are, in general, of an oval form, composed of ill-made thick plates of country iron riveted together.

These boilers hold from 80 to 100 gallons; in each they put from 24 to 30 gallons of the stained juice; the boiler is placed over a draft furnace, which makes the fire burn with great violence, being supplied with a strong draft of air, through a large subterranean passage, which also serves for an ash-hole: at first the fire is moderate, but as the scum is taken off, a point they are not very nice about in these parts, as they look up to quantity more than quality, the fire is by degrees increased, so as to make the liquor boil very smartly; nothing whatever is added to help the scum to rise, or the sugar to gain,

gain, except when the planter wants a small quantity for his own or a friend's use; in this case they add about 10 or 12 pints of sweet milk to every 24 or 30 gallons, or boiler of juice, which no doubt improves the quality of the sugar; the scum, with this addition, comes up more abundantly, and is more carefully removed.

The liquor is never here removed into a second boiler, but is in the same boiled down to a proper consistence, which they guess at by the eye and by the touch; the fire is then withdrawn, and in the same vessel suffered to cool a little; when it becomes pretty thick, they stir it about with stirring-sticks for some time, till it begins to take the form of sugar; it is then taken out and put on mats, made of the leaves of the palmira tree, (*borassus flabelliformis*), where the stirring is continued till it is cold; it is then put up in pots, baskets, &c. till a merchant appears to buy it.

The Hindu name of this sugar is pansadarry; its colour is often fairer than most of the raw sugars made in our West India islands, but it is of a clammy, unctuous nature, absorbing much moisture during wet weather, sometimes sufficient to melt a great deal of it, if not carefully stowed in some very dry place where smoke has access to it.

Many of the planters prefer that sort of sugar which they call bellum, and Europeans jagary, because it keeps well during the wet weather, if kept from the wet. It generally bears a lower price; yet they say this disadvantage is often overbalanced by their being able to keep it, with only a trifling wastage, till a market offers, particularly when the planter has not an immediate market for his sugar; besides, canes of inferior quality answer for jagary when unfit for sugar.

The

The process observed for making jagary differs from the above described, in having a quantity of quick-lime thrown into the boiler with the cane juice, about a spoonful and a half to every six or seven gallons of juice, or nine or ten spoonfuls in the boiler. Here they do not remove the scum, but let it mix with the liquor, and when of a proper consistence, about four or five ounces of Gingeley oil (oil of the seeds of *sesamum orientale,)* are added to each boiler of liquor, now ready to be removed from the fire, and very well mixed with it; it is then poured into shallow pits dug in the ground; they are generally about three feet long, one and a half broad, and three inches deep, with a mat laid at the bottom, which is slightly strewed with quick-lime; in a short time the liquor incorporates into a firm solid mass; these large cakes they wrap up in dry leaves, and put by for sale.

Their jagary is of a darker colour than their sugar, and contains more impurities, owing to the careless manner in which they prepare it, by allowing all the scum to reunite with the liquor.

The half vissum, or one acre of sugar cane, in a tolerable season, yields about ten candy of the above-mentioned sugar, or rather more if made into jagary; each candy weighs about 500lb. and is worth on the spot, from 16 to 24 rupees, according to the demand. In the West-Indies, the acre, (so far as my information goes, and it is chiefly from Mr. Beckford's History of Jamaica,) yields from 14 to 20 cwt. of their raw sugar, worth on the island about 20 l. currency; here the produce is more than double, but, on account of its inferior quality, and the low price it bears on the spot, the produce does not yield a great deal more money than in the West-Indies; however, as here labour is incomparably cheaper, the Indian planter must make much larger profits.

The

The situation of all the sugar lands hereabout is exactly alike, being the middle of an extensive plain, adjoining to the forementioned river; the soil in all is also much alike, so that the produce is nearly equal in all, when no unfavourable circumstances happen: this is farther proved by the quantity of sugar a measure of juice will yield: here it is almost always, except in a very rainy season, or in laid down or wormy canes, about one-sixth part, that is, every six pounds, or three quarts of juice, yield one pound of sugar. In Jamaica, Mr. Beckford says, that, on an average, 1800 gallons of juice may be reckoned to yield an hogshead of sugar, weight 16 cwt. which is, within a trifle, one of sugar, from eight of juice; this proves our juice to be one-fourth part richer than theirs. From the above calculations, it is evident that our lands hereabout are better adapted for this species of culture than the lands in Jamaica: for here they not only yield a larger crop of canes, but the juice thereof is also richer; and were our planters here to bring the melasses, &c. into account, employed in the West-Indies for the distillation of rum, their profits would be still greater; for at present such refuse they give to their cattle, or let their labourers carry away, or use as they think proper; and, by being so employed, I have no doubt but it is productive of more real good than if converted into ardent spirits; let it continue to be so employed, is my sincere wish; for the longer they are ignorant how to convert what is at present wholesome into a poison, the better it is for them; they have already too many ways of furnishing themselves with spirits, particularly near the residence of Europeans.

Here the canes, while growing, seem also subject to fewer accidents than in the West-Indies. I will mention them briefly.

1st. A very wet season is the worst; it injures the canes greatly, rendering them of a reddish colour, yielding a poor unprofitable juice; here they reckon the small heavy pale yellow canes the best.

2d. Storms, unless they are very violent, do no great harm, because the canes are propped; however, if they are once laid down, which sometimes happens, they become branchy and thin, yielding a poor watery juice.

3d. The worm is another evil, which generally visits them every few years; a beetle deposits its eggs in the young cane; the caterpillars of these remain in the cane, living on its medullary parts, till they are ready to be metamorphosed into the chrysalis state; sometimes this evil is so great as to injure a sixth or an eighth part of the field: but, what is worse, the disease is commonly general when it happens, few fields escaping.

4th. The flowering is the last accident they reckon upon, although it scarcely deserves the name; for it rarely happens, and never but to a very small proportion of some very few fields: those canes that flower have very little juice left, and it is by no means so sweet as that of the rest.

Say the average quantity of land employed for the growth of sugar canes in these parts, the zemindaries of Peddapore and Pettapore, independent of what is made on or about the islands formed by the mouth of the Godavary, is 550 vissums, equal to 1100 acres, and to produce at the rate of 10 candy, or about 44 cwt. equal to $2\frac{1}{2}$ hogsheads per acre; the whole produce in hogsheads will annually be 27,500 of 18 cwt. each, which is fully one-fourth part of sugar produced in the island of Jamaica; and I know well, that the quantity might, with advantage to government, I was going to say, but that must be left to be determined hereafter,—I will therefore

say

say, with advantage to the zemindar, farmer, and labourer, be increased to any extent. All the security the planters want, is a strict adherence to the agreement he makes with the zemindar for the land, and a certain market for his sugar, at even the lowest price stated. I observe that the farmer would require to have the agreement he makes for the rent of the land strictly adhered to, because the zemindar raises his demand if the crop be good; so that he will often, in a favourable season, make farmers of all denominations pay probably a fourth more than the original agreement: such injustice they are obliged to put up with, as custom has rendered it common, and they have no idea of applying for redress; yet it no doubt damps the spirit of industry, and prevents the soil from any farther improvement than the bountiful hand of Nature has bestowed on it, which, in these parts, is great indeed.

The planters in these parts very rarely take a second, or what they call carsy crop, from the same field; they say, he is either a very poor or a very lazy farmer that does; because those canes yield less juice, and of an inferior quality, than plant canes; however, poverty obliges some to do so. This carsy crop is cut and manufactured in November, which is a busy season in the paddy fields, &c. As this is the time for reaping the course or early paddy and natcheny, and for sowing various sorts of small grain, consequently attending to the sugar works at that time of the year is inconvenient; besides, the rains are frequent during this month, which is another very great drawback attending this crop. The grand sugar crop fortunately happens during that time of the year (February, March, and April) when there is scarce any other sort of work in the field, consequently both humanity and policy plead in favour of an extended scale

to this, or such other branches of agriculture as employ the labourers at a season when there is little or nothing else to do.

I could never learn that any one had ever depended on a third crop from the same field; for they say, if the second is so much inferior to the first, a third must be still worse; here hands are, or rather were, so numerous, and labour so cheap, that they find it much more profitable to plant every year.

In the Ganjam district, about Aska and Barampore, the natives make most excellent sugar and sugar-candy, but in small quantities; the sugar is in loaves, of a large grain, and often as perfectly white as what is called in England single refined sugar, and the sugar-candy is superior to any thing of the kind I ever saw.

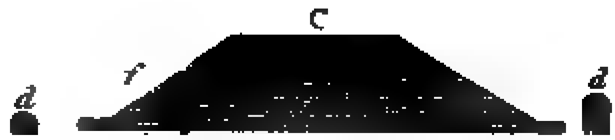
Description of some Improvements on the common Fire-Place. Invented by Messrs. CHARLES *and* RAPHAELLE PEALE.

With a Plate.

From the TRANSACTIONS of the AMERICAN PHILOSOPHICAL TRANSACTIONS.

Messrs. PEALE *have obtained an American Patent for these Improvements after the Communication of the Designs to the Society.*

FIRE-PLACES now in use are often subject to smoke, and the unnecessary consumption of great quantities of fuel, without sufficiently warming the apartments, occasioned by the great quantity of heat escaping through the funnels, consequently being lost in the external air; whereas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whereas those built after the models herewith sent, *are not liable to smoke*, and emit the greatest quantity of heat into the apartments through *cheap*, *durable*, and *salubrious materials* *.

The art of economizing fuel wholly consists in preventing the escape of heat, and directing it where wanted. This is best effected by taking such an entire command of the draught as that, when the combustibles are inflamed sufficiently to continue them to ignition, their hasty destrucion may be prevented by lessening the draught as much as possible without extinguishing the fire.

Jambs considerably slanting, as in the form given by the ingenious Count Rumford, are certainly the best for throwing out heat, and with the addition of the sliding-mantle and valve, or damper, &c. will be found the most *comfortable*, *safe*, and *economizing*.

Explanation of Plate XVIII.

A, is the sliding-mantle, made of sheet-iron or copper; the frame of which may for ornament be covered with plates of brass, and brass may also cover as much of the grooves as are in sight on each side of the fire-place in which the sliding-mantle moves. The arms *a*, *a*, extend to such a length as to free the marble, and let the cord draw perpendicularly over the pullies *b*, *b*; the weights to balance the sliding-mantle, and move freely

* Only a part of these designs are now published, the remainder will form a more general essay of economizing fuel and labour, by various methods, for common use, and more especially for the kitchen; which are now put in practice at the Museum, and most probably will be so far improved as to render them much more interesting to the public, by farther observations and management.

behind

behind the pilasters or frame composing the frontispiece of the chimney.

The grooves which receive the tongues of the sliding-mantle, as well as the pullies, must be fixed firmly in the brick-work, and fitted to set close to the wall forming the front of the chimney.—These are covered by the wood-work and marble slabs, which may be ornamented according to the prevailing fashion.

The dotted lines shew the arms, lines, pullies, and weights in figure B, with the sliding-mantle drawn half way down to the hearth.

The frontispiece will be most convenient if made in two or more parts. That part extending above the projecting mantle-piece, which is to cover the pullies and sliding-mantle, needs only a small projection, and may be made of pannel-work, or an ornamental mirror. It should be separate from the other part of the breast-work, in order to replace the cords when worn out.

Iron hold-fasts drove into the brick-work, to which the breast-work is screwed, is far preferable to the old method of putting wooden plugs, which always shrink with the drying of the mortar, and in a short time leave the frontispiece in a shackling condition; but if screwed to iron hold-fasts, are firm, and such parts as will be necessary to remove occasionally, in order to renew the cords, may be taken down, and replaced in a few minutes.

The marble cheeks as usual are to be fixed firm to the brick-work, covering a part of the grooves, which are to receive the sliding-mantle, but the upper or cross piece of marble is detached from the arch, allowing the sliding-mantle to move behind it, but is supported on the cheeks at each end; and a piece of hoop-iron, the length of the marble,

marble, screwed to the wood-work on the back part, will strengthen and keep the marble in its proper place.

The valve C, made of sheet-iron, is placed about ten or twelve inches above the opening of the fire-place in the throat of the chimney, and fitted to shut close on the top of the brick-work, which should be left flat. The pivots *c, c,* are on the inner front of the fire-place, and are received by the eyes *d, d,* which are fastened into the brick-work. The reason for hanging the valve to the front part of the chimney-flue in preference to the back, is, that the soot which falls on the plate in sweeping the chimney may fall through between the front wall and the valve, when opened. Besides there is more safety in the escape of heat passing up the flue of the chimney at the back than in the front, for too often wood is placed in the brick-work by thoughtless workmen, to the great danger of taking fire. *e,* is a rack, hinged on the under side of the valve at *f,* the lower or rack end to move freely in an iron loop *g,* which is fixed in the jamb. The advantage of this method is, that the valve can be moved with expedition if required, and if the notches forming the rack are close together, the space of opening for the draught may be more nicely adjusted.

The back and cheeks of the fire-place may be made hollow, yet strong, by alternately butting against the wall, in what is termed by the bricklayers *Flemish bond,* —and a small hole made near the hearth of this hollowed way, communicating to the external air if convenient; if not, a hole may be made near the floor within the chamber, and other openings made in any convenient places higher than the opening of the fire-place, to let the heated air pass from the back or inner part of the brick-work into the chamber.

The

The conveniencies of this fire-place are, that the fire may be kindled quickly, and after it burns freely, the valve or damper being lowered, leaving only an opening sufficient to carry off the smoke, which, in a well-constructed chimney, may generally be closed to an inch and half or two inches, but little heat will escape in the throat of the fire-place.

If the chimney is subject to smoke, it is an easy expedient to lower the sliding-mantle so as to increase the draught.

But the safety from the dangers of fire with this fire-place is not of the least importance, for whatever fire is left in the place at night, with the valve close shut, and the sliding-mantle lowered to join the hearth, the fire will be smothered. In like manner if by accident the soot takes fire in the flue of the chimney, no alarm follows, as it may instantly be extinguished.

The last improvement which has been made, is to remedy the evil of the smoke passing between the sliding-mantle and breast-work, and escaping through the crevices round the mantle-piece.

A hole is made in the brick-work in the middle, a little above the opening of the fire-place, forming a small flue to let in the external air, by which the smoke is driven back into the chimney. This has been found to have an admirable effect even in some chimnies which before had smoked so as to be deemed incurable.

On

On the Composition and Use of Chocolate.

By M. PARMENTIER.

From the ANNALES DE CHIMIE.

AMONGST the substances with which the conquest of the new continent has enriched the old is the cacao. With this fruit or more properly with this seed, the Mexicans, from time immemorial, prepared their favorite beverage, chocolate. It was composed of cacao burned, pounded, and diluted with water; to this they added maize flour to give it a consistence, and pimento to season it. They were strangers to the existence of sugar, for the cane indigenous to India beyond the Ganges was not introduced into St. Domingo till the year 1506 by Desticaca; and Balastro was the first that submitted this plant to the mill in America.

The Spaniards acquired from the Mexicans their extravagant notions on the wonderful properties which they ascribed to chocolate; the preparation of it, rude as it at that time was, soon became an object of speculation in their hands; they made a secret of it, and sold, and even still sell, to other nations, as chocolate a mere paste of burnt cacao, pounded and made up in cylindrical rolls.

The cane being transplanted into our colonies rendered the use of sugar more common in Europe; it soon became general, and the Spaniards introduced it into the preparation of chocolate to correct the disagreeable taste of that beverage to any person not accustomed to it: but it was not till long after, that other nations discovered that cacao formed the basis of it, that sugar was the seasoning, and that cinnamon and vanilla were the spices employed.

employed. This discovery became the patrimony of a number of individuals, who in their turn made a secret of it; hence arose the chocolates of Italy, Portugal, and Spain, which upon comparison are in no respect superior to those prepared at Paris and other towns of France. How, indeed, should those countries possess any advantage over us in that respect? The materials of which chocolate is made are not cultivated there any more than with us; both they and we procure them from the same sources, at the same expense. Besides, at Naples, Lisbon, and Madrid, French chocolate has the same preference: but it is decreed that none shall be a prophet in his own country, and that proverb is likewise applicable to chocolate.

I shall not examine whether chocolate is actually deserving of the praises lavished upon it, and whether it is proper in all circumstances in which it is recommended to be taken. If we are to believe the writings of the physicians of the two worlds, nature has infused into the cacao a remedy for all the disorders that afflict mankind, and the means of prolonging life beyond its usual term. But it is difficult to avoid exaggeration, particularly when speaking of productions that frequently possess no other merit than that of growing at a great distance from us, and in another hemisphere. Experience and observation have only taught us that chocolate, when rightly prepared, is a light, innocent aliment, and easy of digestion; on this account it is particularly prescribed for convalescents, for persons of delicate constitutions, and those advanced in years. But in order to produce invariably beneficial effects, the ingredients of which it is composed must be judiciously selected, well prepared and perfectly mixed, so as to form a fine homogeneous paste.

On

On the other hand, when we reflect on the nature of the substances of which chocolate is composed, and the manner of effecting their combination, we are compelled to acknowledge in it all the characteristics of a preparation perfectly pharmaceutic, and to confess that it requires a variety of precautions, and an intelligence of which mere workmen are not susceptible without superintendance, and without direction.

The selection of the cacao is not sufficient to give the chocolate the quality it ought to have; the fruit should be passed through a sieve, then dried with a gentle heat to deprive it of humidity, and to develop the smell and taste peculiar to it; it must be picked grain by grain to separate from it the skin, the germ, or shoot, and such of the kernels as appear to be spoiled: the cacao thus picked, must be pounded for a long time with a certain quantity of sugar on a stone heated gradually on a sand bath. The remainder of the sugar must not be added till the second pounding, towards the conclusion of which operation the pulverized spices are thrown in together with the sugar. It is then divided into masses of any determined weight, and put into tin moulds, out of which it is taken when cold and wrapped up. Care must be taken to keep it in a dry, cool place. Winter is the most favorable season for its preparation.

As the different kinds of cacao, if employed separately, would not afford chocolate of a good quality, it is usual to mix them in certain proportions, according to the price at which the chocolate is to be sold, and the fancy of the consumers: sometimes no other spice than cinnamon is introduced into the composition; when vanilla is mixed with it, it is in the proportion of a half, one, two, or three of the shells of that fruit to a pound, as the weight of those shells is very unequal.

 Chocolate,

Chocolate, thus composed, is infinitely preferable to the mere paste of cacao, which is still prepared in the Antilles, and which the Spaniards continue to send us, pretending that it is more convenient in that state, because a person may add sugar and spice in whatever proportion he pleases, when he is going to make use of it; but the beverage thus produced is never perfectly homogeneous. The butter of the cacao is always seen floating on the surface; whilst, on the contrary, when the sugar is mixed and pounded with the cacao upon the stone, a more intimate combination of all the principles takes place in the mixture. In short, a more thoroughly incorporated chocolate is obtained more readily dissoluble in water, and consequently more easy of digestion; besides, although cacao does not become rancid so easily as some fruits of a similar nature, it is to be feared that if submitted too suddenly to the action of the heat necessary for pounding the kernel, the oil or butter which it contains may lose its natural sweetness, and become acrid and inflammatory.

Of the Frauds committed in the Manufacture of Chocolate.

In a commerce from which we should expect that the love of humanity, that pure and natural sentiment, would banish every intention to deceive, every motive of sordid interest, it is doubtless distressing to see, nevertheless, that frauds are multiplied in proportion to the number of different hands through which the articles pass, in order to acquire an alimentary or medicinal property. My intention is not to accuse all, but the mal-practices of some manufacturers of chocolate oblige me to recommend certain precautions, which are most assuredly unnecessary with regard to many, who fulfil the duties of their

their useful profession with an integrity worthy of the golden age.

Baumé, in his *Elements of Pharmacy*, and Demachy, in his *Art of Distilling*, have pointed out part of the frauds committed in the manufacture of chocolate. I shall think myself happy, if by adding a few observations to those published by the above chemists, I secure to chocolate the reputation which it justly deserves, and which it has lost in the opinion of some individuals, through faults in its preparation, or the addition of matters foreign from its composition.

Amongst the many persons whom I have heard complaining of chocolate, I shall mention a woman, of a pretty strong constitution, who had been directed to take it by way of medicine; the injurious effects she experienced from it gave me reason to suspect the quality of her chocolate; I examined it, and found that it contained an abundant farinaceous matter. Now this substance was expressly forbidden her by her physician; I persuaded her not to discontinue the use of chocolate, but to procure some elsewhere; the indisposition, indigestion, and flatulencies, by which she was tormented, left her, and she gradually recovered. Thus the very thing to which she was indebted for her cure, would, perhaps, in time, have proved fatal to her.

I was induced, by this circumstance, to examine other kinds of chocolate bought promiscuously of several manufacturers. I found some of them perfectly well prepared; I likewise found some that contained wheat-flower; others the flower of lentils, peas, and beans, and even the feculæ of potatoes. These substances, it may be urged, are innocent in the animal economy; I admit it; but in circumstances where chocolate forms part of a diet, and is prescribed as a medicinal aliment, they must

be

be extremely prejudicial to health. But if this were not the case, why should they be introduced? They are absolutely foreign from the composition of chocolate. These observations apply to all those additions so highly extolled in the advertisements distributed by quacks in this line, and which have even met with encouragement.

But supposing what is not the case, that it were necessary to make chocolate thicker and more substantial, the mixture of the substances should not take place till the moment of its preparation, and in a manner under the eye of the consumer. I must observe, that if it be thought useful to add farinaceous substances, they should always be employed in the state of feculæ or starch, because then they are deprived of the glutinous or extractive substances, and contain only the real alimentary substance.

The composition of chocolate must be distinguished from its preparation; the latter is the business of the consumer; he may mix with it the yolks of eggs, to give his beverage a more saponaceous character, and may use milk instead of water to augment its nutritive quality. It is even remarked, that many people who cannot take milk without its instantly turning sour, are capable of digesting it with the assistance of a little chocolate; but it must be repeated once more, that when it appears proper to the physician to prescribe it, it is a medicine, on the effects of which he cannot rely if its composition be arbitrary and variable.

There are still other frauds more prejudicial to the effects of chocolate than I have yet discovered in my examination; some manufacturers procure, at a low price, the residue of the cacao paste, from which the butter has been extracted, and substitute in its stead oils or animal fat; others add roasted almonds, gum-tragacanth, and

and gum-arabic; lastly, there are people who procure bitter fresh-gathered cacao, which may always be had at a cheap rate, and from its quality takes a much greater quantity of sugar, which contributes to diminish still more the price of the chocolate.

We must, however, observe, that with the purest motives chocolate, without containing any thing of a foreign nature, may be defective from the ingredients of which it is composed being badly selected, or because the first operation may have been neglected in some particulars. The whole art consists in the choice of cacao of proper quality, and in avoiding the two extremes of drying. If it is not sufficiently roasted it retains a disagreeable flavour; but if it is burned, besides the bitterness which it contracts, the beverage prepared with it is of a black colour, and wants that unctuous quality that we like it to possess. Lastly, if the germ is not separated from the two lobes of the fruit, being of a hard and horny nature it resists the action of pounding and boiling, and is found at the bottom of the cup of chocolate in its integral state: its presence even attests that the first operation, which consists in picking the cacao grain by grain, has been neglected, and that the other subsequent operations have not been more carefully performed.

Another observation is, that most workmen employed in making chocolate require strict superintendance of the master, otherwise they neglect to pound the paste properly, and to spare labour and time they apply a too powerful degree of heat, which is extremely prejudicial to the quality of the chocolate.

Methods of discovering Frauds.

It is not sufficient to point out the frauds that are practised in the manufacture of chocolate, and all the

defects

defects proceeding either from negligence, improper selection of the materials, or the preparation. We shall have fulfilled only half our intention if we do not enable the consumer to distinguish them so as not to be deceived by them.

With good organs it is easy to judge of the quality of chocolate: its fracture should exhibit nothing of a gravelly appearance. When tasted it should melt in the mouth, and in melting should leave a kind of coolness, and when converted into a liquid in water or milk should acquire only a moderate consistence.

Whenever chocolate fills the mouth with a flavour of paste, and the liquor at the first boiling exhales a smell of paste, and after it has grown quite cold is converted into a kind of jelly, a person may be sure that the chocolate contains a farinaceous matter more or less abundant in proportion as the abovementioned effects are more or less powerful; if it deposits at the bottom of the cup small solid bodies, an earthy or gravelly sediment, it is a proof that it has been badly picked, and that brown sugar more or less coarse has been employed instead of white. The smell of cheese indicates the presence of animal fat; and rancidity, that of emulsive seeds: lastly, a bitter, sour, or musty taste, proves that the cacao employed was too green, too much roasted, or damaged.

It cannot be too often repeated that the preparation of chocolate is not a matter of indifference; it does not require any great knowledge or talents, but probity and attention; the makers of chocolate should leave to the consumers the addition of any thing they may think proper, to increase its efficacy, or to render it more agreeable; and the consumer ought not frequently to complain so much of its indifferent quality, as of his own

misplaced

misplaced confidence, and imperfect acquaintance with his constitution; for chocolate is of real value, and yet many people wish to pay for it only half what it is worth, whilst others, running into the contrary extreme, pay far too high a price.

My limits will not admit of a description of the distinguishing characteristics of the different kinds of cacao, nor of an examination of the prime cost of chocolate to the manufacturer; those details will be the subject of a separate memoir.

From what has been already said it results, that chocolate is no longer what it was when the Spaniards conquered Mexico at the beginning of the sixteenth century; there exists no particular method of preparing it; that if the ingredients which compose it vary in their proportions, the process for incorporating and consolidating them into a perfect whole should be regular and invariable; that its quality depends on the choice of ingredients, and the attention bestowed on their combination; that it is adulterated by carelessness, avarice, and quackery, so as to form a heavy, heating beverage, and difficult of digestion; that to procure it with all the qualities of good chocolate, the purchaser must deal with persons whose integrity can be relied on, and consent to pay its real value for it; and, lastly, that every person who introduces into the composition of chocolate materials which should not form a part of it, excepting by the directions of the consumer, makes a direct attack upon health. Let the adulterator be informed, and always bear in mind, that, however he may attempt to envelop himself in the veil of mystery, and hide himself in obscure corners, in order to introduce low-priced materials into chocolate, he cannot escape chemical analysis, which instantly reveals his frauds, and denounces his fatal art and his name to public animadversion.

To the observations contained in this notice I shall add those which M. Cadet has lately communicated to me on the chemical analysis of some aliments, in his own words.

"The prefect of police having recently requested me to analyse a quantity of chocolate, which was suspected to contain some hurtful substances; I shall not enter into a detail of the numerous experiments necessary for this examination, but shall confine this notice to a remark grounded on the following fact:

To ascertain whether this chocolate contained any metallic substance, I reduced it to ashes; these I washed with very pure nitric acid, which held in solution all that was soluble. This ley when filtered was clear, but the moment I poured into it a hydro-sulphuret, I obtained a black and very abundant metallic precipitate. This result gave me much concern, because I was still ignorant of the nature of the metal, and it is always distressing to find a poisonous substance in any kind of aliment. I treated the ley with prussiate of potash, and a beautiful Prussian blue was instantly formed, which relieved me from my apprehensions. I continued to try different re-agents, and oxalic acid convinced me of the presence of lime. It was interesting to ascertain if the iron and lime which I discovered were to be found in all chocolates: I therefore analysed Caracca cacao, and the best cacao of the islands; I found in them neither lime nor metal. I then with great care prepared chocolate with the same cacao, and very fine white sugar; the analysis of it produced a large proportion of iron and lime. It is therefore in fabrication that those two substances are introduced into chocolate, and the more care is bestowed on the manipulation, the greater is their quantity. The cacao is roasted in a cylinder of plate iron,

iron, like those used for coffee. It is then pounded in an iron mortar, and rolled with an iron roller on a calcareous stone, the surface of which wears away with the friction, and furnishes the lime.

If cacao were to be roasted in a vessel of metal less subject to oxydation, or of well baked earthen-ware, and if it were ground on granite or porphyry, with a roller of the same material, the chocolate would contain neither lime nor iron. In manipulations on a large scale, metallic substances are frequently introduced into the articles of fabrication. Thus the extract of tamarind, and particularly liquorice juice, contain so great a quantity of copper that the metal is frequently discoverable at first sight. Apothecaries are therefore obliged to purify it, to prevent the serious accidents that might otherwise be occasioned.

I was curious to ascertain the proportion of the metal, and of the earth introduced into chocolate in making. I repeated the experiments, with care, on quantities exactly weighed, and I ascertained that 5 hectogrammes (a pound) contained 24 decigrammes (48 grains) of lime, and 20 decigrammes (36 grains) of iron; this proportion is the minimum. Thus a man, who takes a cup of chocolate daily, swallows annually 864 decigrammes (3 ounces) of lime, and 740 decigrammes (2 oz. 2 dwts.) of iron.

As iron is a salubrious metal, and the proportion of lime is not very considerable in chocolate, we need be under no apprehension in using that aliment; yet, I believe, physicians will agree in the utility of collecting the analyses of different substances that serve as nourishment for man. Till we have attained our full growth, it is necessary for the developement and solidification of the bones, that we should take with our food a certain quantity of lime. The labours of Messrs. Vau-

 quelin,

quelin, and Alexandre Brongniart, will, doubtless, be recollected; they found lime in flower, and calculated that a man who eats a pound of bread *per* day, must have eaten nearly two pounds of lime by the end of the year.

When man has arrived at mature growth, he has no necessity for the same quantity of lime; thus it is found abundantly in his urine, &c. but as in the different processes of digestion this earth meets with various acids that combine with it and form salts, most of which, as phosphate and oxalate, it is difficult to dissolve, it frequently disorders the organs most necessary to life; we know that it forms the basis of most urinary and gouty calculi. It is therefore of the highest importance for the progress of medicine to examine the aliments that contain this earth, in a perceptible manner. Messrs. Vauquelin, and Alexandre Brongniart, found it in abundance in bread; I discovered it in chocolate.

M. Delaville, in No. 132 of the Annales de Chimie, in speaking of the juice of the cabbage, says this juice, when evaporated, furnishes a considerable quantity of sulphate of lime; the juice of radishes gives nearly similar results.

Thus it appears that these four kinds of food, which are frequently taken at the same time, introduce into the digestive canals a very considerable quantity of lime. I might mention others, as certain kinds of cyder, purified by the dealers with chalk; and I have thought that these facts are not unworthy the attention of physicians. A comparison of similar observations, apparently of little importance, often explains the cause of the phœnomena belonging to physiology. Nothing should be neglected in animal chemistry, the principal aim of which is the preservation of health, and the destruction of the most fatal diseases that afflict humanity.

Method

Method of obtaining Metallic Cobalt perfectly pure.

By M. Tromsdorff.

From the Journal de Chimie.

Mix a pound of the best saffre with four ounces of nitrate of potash and two ounces of pulverized charcoal, and throw this mixture in small portions into a red-hot crucible. Repeat the same operation three times; at the third time leave the matter exposed for an hour to a white heat; remove it rapidly, and add four ounces of black flux, place the crucible in the furnace, and let it remain perfectly red-hot for an hour. When cold, separate the reduced part of the cobalt, which, in consequence of the treatment to which it has been subjected, has lost great part of its arsenic and iron, but is not yet quite pure, since it may still be easily pulverized, although its natural density is very considerable. It must then be mixed again with thrice its weight of nitrate of potash; the mixture is made to deflagrate in small portions in a red-hot crucible, and is kept at that heat for a certain time. By this last operation the iron is completely oxydated, the arsenic is converted into acid, and taken into combination by the potash. By levigation with warm water all the saline parts are carried off, and the oxyd of cobalt is separated by the filtre. The oxyd is dissolved in a suitable quantity of nitric acid; the solution is filtered and evaporated to dryness. Add fresh acid, expose it to a moderate heat, dilute it with a sufficient quantity of water, filter it to separate the last portions of iron, precipitate it with pure potash, and then reduce it.

Method

Method of preparing the Extract of Opium.

By M. BARRIER, *Apothecary at Pontarlier.*

With a Plate.

From the ANNALES DE CHIMIE.

THE expense of a fire for six months is sufficient to deter the artist, and to oblige him to purchase at a very dear rate an essential preparation, in the quality of which he is almost always deceived.

The following is a very economical method of preparing the extract of opium, which was attended with complete success, and may be applied to many other purposes.

Make an aperture at the bottom of the flue of a stove seven or eight inches high, and about an inch and a half wide (see Fig. 2, Plate XIX.); then procure a tin kettle or coffee-pot, a foot and a half high, in the form of a crescent, so as to surround half the circumference of the flue; its diameter, where widest, will be about three inches, and will diminish gradually to the two extremities like a half moon.

In the concave part of this boiler, which is placed against the flue, make towards the bottom a longitudinal aperture, corresponding with that in the flue, and solder at this aperture of the boiler a small box A, seven or eight inches in height, one inch and a half wide, and projecting three or four inches. This box, which communicates with the interior of the boiler, is inserted in the aperture of the flue, and immediately receiving the heat and flame, the liquid it contains is soon heated either to ebullition or the degree of heat required.

The

The top of the boiler, which is covered, and well soldered, has a neck three or four inches high, and three in diameter; through which the vapour passes, and is received in a small chimney, in the form of a funnel reversed, the upper end of which, of a square figure, connects with the flue, and conducts the prejudicial vapours into it.

On one of the sides of the boiler is placed a tube C, like the case of an areometer, about a foot long, which, by means of the small communication D towards the bottom, receives the liquid from the interior. In this tube is put a small bottle, in the cork of which is fixed a wire E, which indicates the diminution of the fluid by descending with it. The fluid should never be suffered to fall lower than the top of the box, fixed in the flue of the stove, for fear the solder should melt, and the wire should be placed in such a manner that when it descends to the level of the tube F, it should indicate the diminution of the fluid to the level of the box, and the necessity of adding more water. This small lateral tube terminating in a funnel, is very convenient for replenishing, and even if it be uncovered it emits no kind of smell.

This boiler contains about six quarts; yet it can be employed only for the preparation of 1½ lb. of opium instead of 3 lbs. according to the formula in Baumé's Elements of Pharmacy, which must be followed in other respects; and if one winter is not sufficient for this preparation, nothing prevents its being interrupted and resumed the following winter, as is my present practice. A vacancy of a few inches should be left for ebullition, and it is better for the top to be of a wider diameter, to prevent boiling over. The ebullition may be moderated

at

at pleasure, by gradually removing the boiler from the flue by which it is heated.

By altering the proportions and form of this machine, it may be employed for many purposes beneficial to society and the arts, with singular advantage in point of economy.

Method of correcting some Inconveniencies arising from the Inequality of the Fire in Distillation on a large Scale.

By M. EDELCRANTZ.

With a Plate.

From the ANNALES DE CHIMIE.

DISTILLATION, as is well known, consists principally of two operations; the conversion of the material to be distilled into vapour by means of fire, and the condensation of this vapour by cold. That this two-fold object may be accomplished with expedition, and without unnecessary consumption of fuel, it is requisite to establish a perfect equilibrium between the vaporising heat and the condensing cold: that is, by supposing the latter constant, as it may be made in practice (a given quantity of water, of a fixed temperature, passing in a determined time through the refrigerant). The fire should be regulated in such a manner that the quantity of vapours produced should be neither greater nor less than what can in the same space of time be condensed by the cold applied. The want of attention to this circumstance, particularly in the distillation of spirits, produces the two following inconveniencies:

1. If

Fig. 1. Page 456.

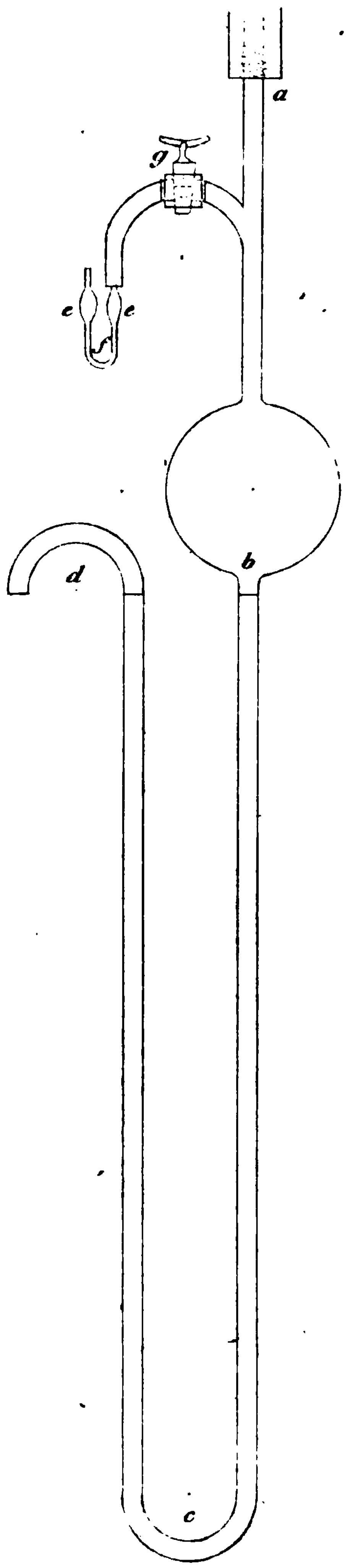
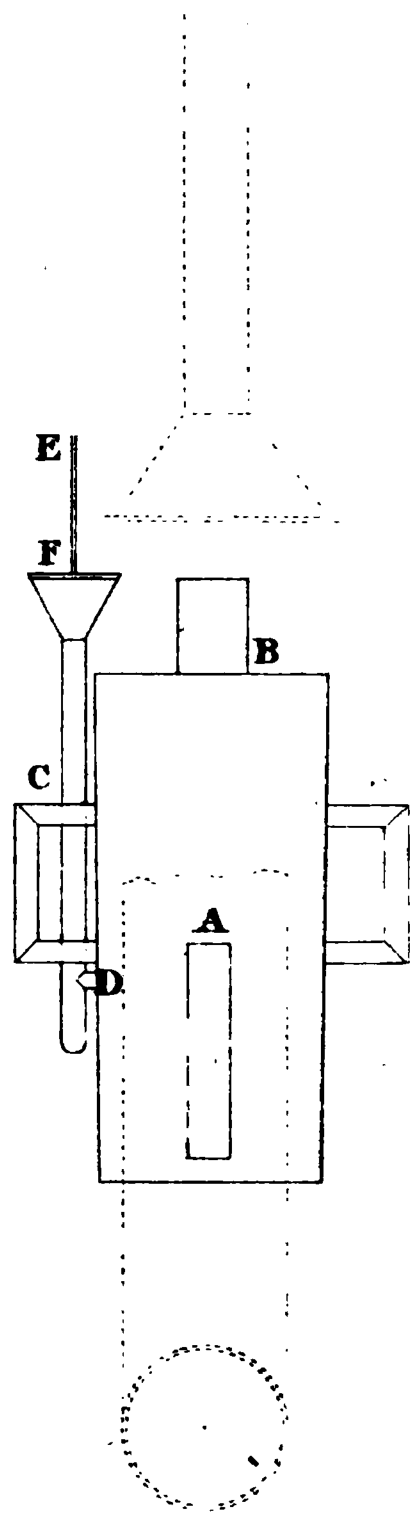
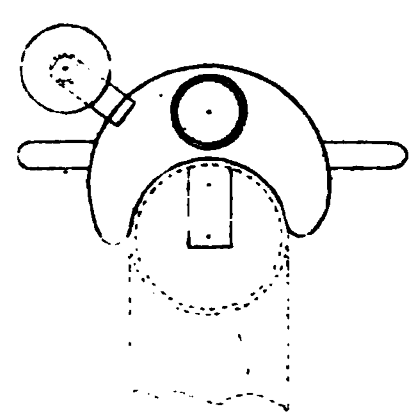


Fig. 2. Page 454.



Plan & Elevation of the boiler.



1 Metre.

1. If the fire is too strong, a great portion of the condensed vapours passes from the worm into the external air, which occasions a loss of the distilled matter and of fuel.

2. If the fire gets too low, the condensation produces a void in the worm and in the still, which not being filled in the same proportion by fresh vapour, obliges the external air to enter, by which the vaporisation and condensation are rendered difficult: and when that air is again forced out, it carries with it part of the vapour, and occasions a loss of the distilled matter and of time.

To remedy these defects, and at the same time to furnish a simple method of indicating at every moment the actual state of the fire, I contrived an instrument which may be adapted to every apparatus for distilling, and which is nothing more than an application of theoretical principles already known.

Fig. 1, (Plate XIX.) *a*, *b*, *c*, *d*, is a curved copper or glass tube, in several pieces with a ball *b*; the upper end of the tube *a* may be attached by means of a screw to the worm. The length *b c*, *c d*, is four feet, and the capacity of the ball *b* is somewhat greater than the whole capacity of the tube *b c d*. When the distillation is going on, the condensed vapours will pass through *a* and the ball *b* into the tube *b c d*; and the liquor will not run out at *d* into a vessel placed to receive it, till the two arms are filled. Thus these two arms will remain full during the whole time of distillation, and in this circumstance consists the remedy to the above-mentioned inconveniences. It is obvious, that if the fire be too violent, the vapour not condensed cannot be dissipated by opening a passage into the external air before it has expelled all the liquor contained in the tube *b c*, and overcome the pressure of

 a column,

a column, the height of which is equal to *c d*. In the second case the external air cannot enter to fill the void occasioned by the lowness of the fire, except by expelling the column *d c*, and surmounting a pressure of the same height. Thus this column being four feet, gives sufficient latitude and time to the workmen to regulate the fire in consequence. If the tube *b c d* be of glass, they need only observe the height of the liquor in both branches: when low in *b c*, it proves that the fire should be diminished, and in *c d*, that it should be augmented. But tubes of this length being liable to accident, I prefer attaching a small glass regulator *e f e*; the two arms of which *e f*, each three inches in length, contain mercury, which, by rising alternately in one or the other, indicates with the greatest exactness the state of the fire, and of the vapours. This regulator may be enclosed in a decanter or bottle, to preserve it from accident. Between it and the worm is a cock *g*, which at first communicates with the external air; but if upon encreasing the fire the vapour is seen issuing from *g*, by turning the cock a communication is opened between the worm and the regulator, which commences its office. The ball *b* prevents the liquor propelled by the external air from rising into *e f e*, and into the still. It is superfluous to add, that the junction, of whatever material the instrument be formed, should be well luted, to prevent the entrance of external air.

On

On the Application of Platina to Porcelain.

By M. Klaproth.

From Scherer's Journal der Chemie.

PLATINA has not yet been applied to my knowledge to encaustic painting. I therefore thought it would be useful to make a few experiments on the subject, and they have not fallen short of my expectation.

Gold and silver are the only metals that have hitherto been employed in a metallic form, in painting, or otherwise ornamenting porcelain, glass, or enamel. Gold answers this end completely, but silver is far from affording such satisfactory results. As it is less dense than gold, it cannot be applied in such thin pieces as the latter metal, and it does not cover porcelain and other articles so well. Another reason why silver is less applicable in painting on porcelain is, because its metallic brilliancy is injured by sulphureous exhalations, which turn it black. This unfavourable circumstance prevents silver from being employed in fine encaustic painting, and confines the use of metallic substances for this kind of painting to gold.

Platina, on account of the qualities it possesses, ranks next to gold, its white colour renders it an excellent substitute for silver, from the defects of which it is exempt. It not only completely covers the ground from its density, which even surpasses that of gold, but, like that metal, it resists all the variations of the atmosphere, and is not at all tarnished by sulphureous exhalations.

The process of application is very simple. The platina is dissolved in nitro-muriatic acid, and precipitated by a

solution of muriate of ammoniac. The red and crystalline precipitate thus formed is dried, reduced to a fine powder, and gradually brought to a red-heat in a glass crucible. The muriate of ammoniac, precipitated in combination with the platina, is sublimated, and the metal remains at the bottom of the crucible in the form of a light grey powder. This powder is mixed with a small proportion of flux, as is usual with gold, is ground with oil of spikenard, applied to the porcelain, which is then baked and burnished.

The colour of platina applied in this manner to porcelain is of a silver-white, inclining a little to an iron-grey. By mixing this metal in different proportions with gold, various shades of that colour are obtained. Platina can absorb a great quantity of gold before its change of colour to yellow is perceptible. For example, in an alloy of one part of platina with four of gold, the presence of the latter metal cannot be perceived, and the colour is scarcely different from that of pure platina; the colour of the gold predominates only in the proportion of eight to one.

The mixture of platina with silver produces a very dull effect.

Besides this method of applying platina to porcelain, it may be laid on in a state of solution. In this latter case, its colour, brilliancy, and appearance, are very different. By evaporating the nitro-muriatic solution of platina to a certain consistence, and by laying it on the porcelain at several times, the metal penetrates into the substance of the porcelain, which, when baked, presents a metallic mirror, of the colour and brilliancy of polished steel.

Experiments

Experiments demonstrating the Presence of Prussic Acid, completely formed in several Vegetable Substances.

By M. VAUQUELIN.

From the ANNALES DE CHIMIE.

SINCE Scheele published the method of obtaining perfectly pure prussic acid, all chemists have discovered a striking similarity between its smell, and that of several vegetable matters; such as the flowers and leaves of the peach tree, the bitter kernels of fruit, as peaches, apricots, plumbs, cherries, &c.

M. Fourcroy and myself have often conversed on this singular similarity; we have frequently resolved to examine whether those different substances contained prussic acid, and last summer we even collected a large quantity of the stones of apricots for the purpose of putting our designs in execution; but other occupations have hitherto prevented it.

M. Friedländer having lately informed me that M. Schrader, an apothecary of Berlin, had found prussic acid completely developed in bitter kernels, the leaves of the peach-tree, &c. I made some experiments to ascertain the truth of this information. As I was totally ignorant of the processes which M. Schrader employed to discover and extract prussic acids from the substances which contain it, I may possibly have obtained results different from his, so that the nature of his labours cannot be judged of by what I am about to detail.

Experiment 1. Sixty grammes of apricots, pounded and mixed with the same quantity of water, were submitted to distillation in a retort placed on a sand-bath: when the greatest part of the water had passed over, the operation

operation was suspended, and though it had been conducted slowly and with care, yet the part of the kernels which touched the bottom of the retort was rather burned.

2. The liquor obtained by this distillation was clear, and without colour; its smell, similar to that of bitter almonds, was very strong, and its taste extremely bitter.

3. Mixed with the tincture of turnsol, it only tinged it a light red.

4. To ascertain whether this liquor contained prussic acid, I mixed with it a few drops of solution of iron; I precipitated the latter by ammoniac, and, after having agitated this mixture for a few moments, I added to it diluted sulphuric acid, which dissolved part of the oxyd of iron, and left a blueish-green matter, which an excess of that acid was incapable of dissolving. This precipitate retained its green colour several days, but it assumed a blue tint with the heat of boiling water. Alkalies took away its colour, and converted it into a yellow matter, which proves that it was actually prussiate of iron.

5. As the apricot kernels were rather scorched during distillation, I was afraid the prussic acid which I had obtained had been formed by the re-action of the principles of the vegetable matter. To satisfy myself on this head, I distilled with a balnea mariæ five hectogrammes of bitter almonds pounded, with the addition of a like weight of water. When half of it had passed over, I put it aside, and continued the operation till completed.

6. The first portion of this liquor turned the tincture of turnsol a light red; when mixed with a solution of sulphate of iron and ammonia, it formed a precipitate which was not entirely dissolved by sulphuric acid, and which became blue by ebullition.

7. The

7. The second portion of the liquor likewise reddened the tincture of turnsol, but it yielded less precipitate with iron by the method above mentioned.

This experiment seems to prove that prussic acid exists, completely formed, in all bitter kernels, and in those of apricots; but it is not probable that a degree of heat, inferior to that of boiling water, is capable of developing it by means of the re-action of the principles of those substances.

Thus the discovery of this acid in the kernels of fruit-stones by M. Schrader cannot be doubted, since I discovered it by processes perhaps quite different from those he employed.

But I cannot believe that the prussic acid exists in the above-mentioned substances in the same state as in the lixivium of calcined blood with potash; because instead of furnishing like the latter a blue precipitate with iron, it yields a green one, which seems to indicate that it is oxygenated.

It is very similar in its effects to that obtained from animal substances, and from some vegetable matters, by the action of nitric acid.

I likewise doubt whether the extremely bitter taste and smell of the water distilled from these vegetable kernels be entirely owing to the presence of prussic acid; at least, if we judge by the quantity of Prussian blue it furnishes, we find that effects are not always proportionable to the cause. What appears to prove this is, that after having precipitated this acid with iron, the liquor still in part retains its bitter smell and taste. But possibly this acid may be in a state not calculated to combine with iron; or, at the moment when sulphuric acid is added to the mixture, part of it may be re-dissolved in the liquor.

8. After

8. After distilling the almonds in the balnea mariæ with water, I wished to ascertain whether by decomposing them with a more powerful heat they would furnish more prussic acid, but I could discover no traces of it in the produce; therefore the whole of the acid contained in the almonds is extracted and volatilised by the mere heat of boiling water.

I have remarked that the smell of the produce of almonds thus distilled was very similar to that of animal matters, and that this produce likewise contained a great proportion of ammonia.

9. I wished on the same occasion to try whether at the temperature of boiling alkohol the prussic acid would rise in vapour. I therefore distilled 60 grammes of apricot kernels with double the quantity of alkohol: the latter, during the operation, acquired a bitter taste, but I could not by any method discover the presence of prussic acid. This seems to prove that the smell and taste of bitter almonds, and those which they communicate to different substances, are not produced only by prussic acid, at least in the state in which it forms Prussian blue with iron.

It results from these experiments, 1, that bitter almonds, the kernels of apricots, and without doubt those of peaches, plumbs, cherries, &c. contain a small quantity of prussic acid, completely developed, and capable of forming a green precipitate with iron, which proves that it is oxygenated; 2, that when we take orgeat, emulsions, or any other composition in which bitter almonds are employed, we take at the same time a certain quantity of prussic acid; 3, that we are now enabled to account for the similar effects produced on birds, and even on men, by the distilled liquor of bitter almonds, of the bay tree, and prussic acid; 4, that prussic acid must henceforward be accounted one of the immediate principles of vegetables.

FIG. 1.

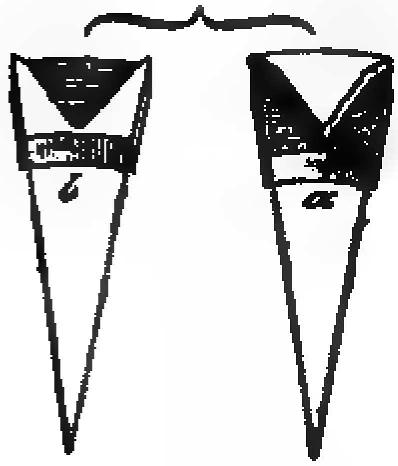


FIG. 2.

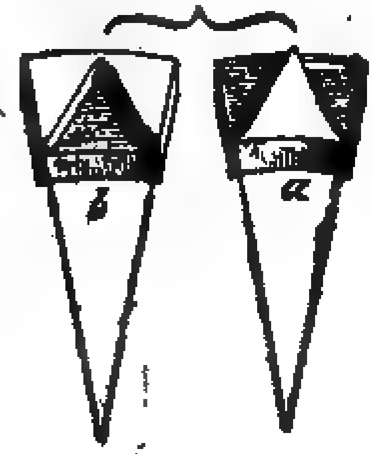


FIG. 3.

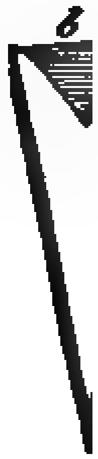


FIG. 4.

FIG. 5.

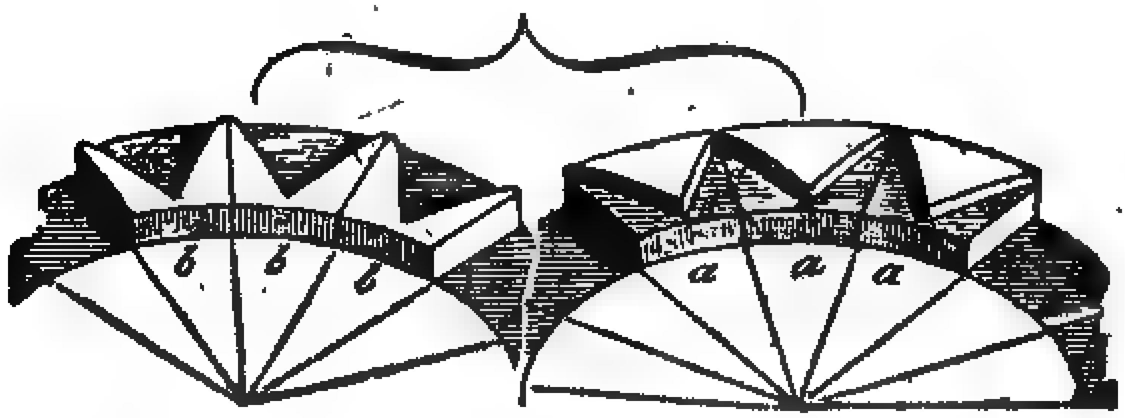


FIG. 6.

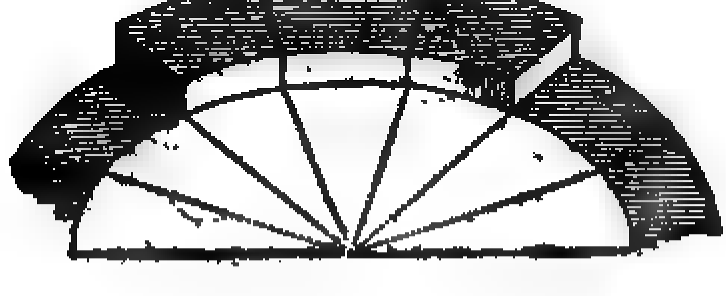


FIG. 7.

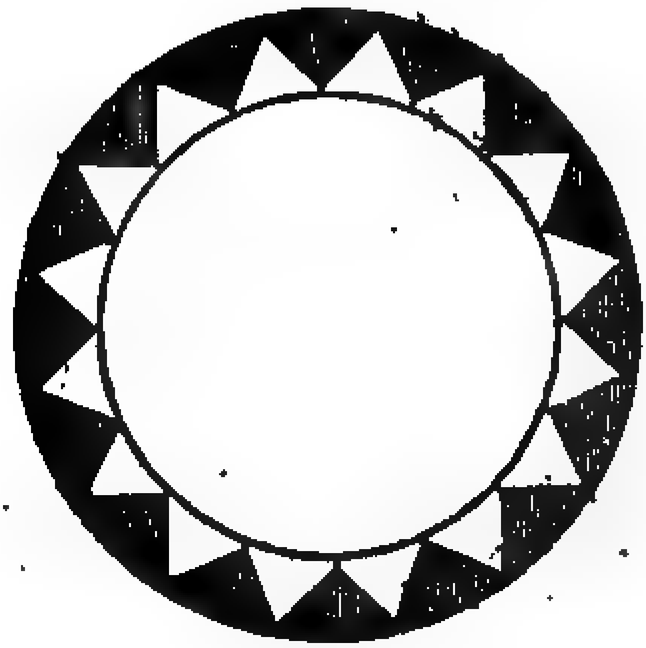


FIG. 8.

FIG. 9.

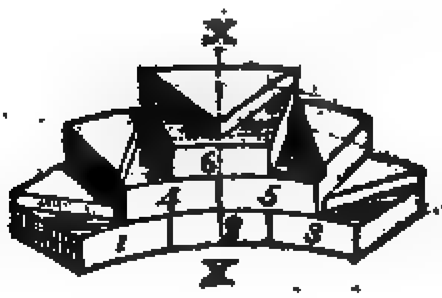


FIG. 10.

FIG. 11.

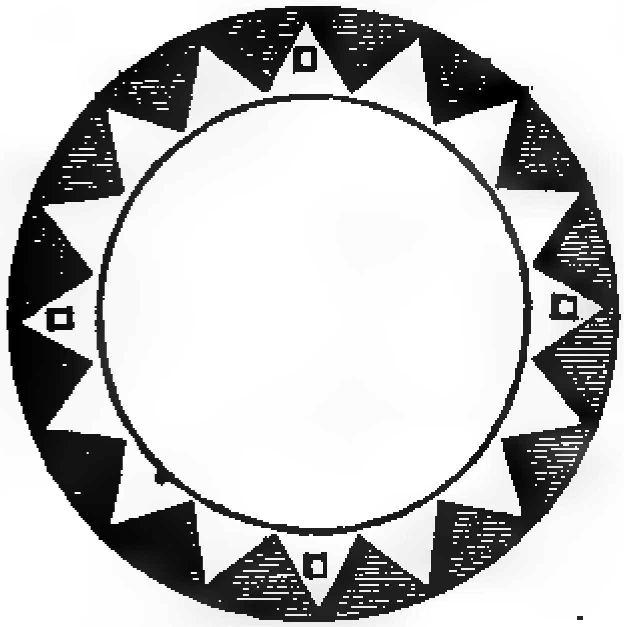


FIG 12.

FIG. 13.

Chemical Examination of the Juice of the Papaw Tree. *By* M. Vauquelin.

From the Annales de Chimie.

THE vegetable which furnishes this juice has been denominated by botanists *carica papaya* (diœcia decandria); it grows in the Isle of France, in Peru, and doubtless in many other countries.

The juice of which I shall here present the chemical analysis, was brought from the Isle of France, by M. Charpentier de Cossigny, who had seen it successfully employed by the natives of that country against the solitary worm.

Although the trials hitherto made by the physicians of Paris for the same purpose have not corresponded with the hopes entertained, in consequence of M. de Cossigny's information; yet it has been conceived that a chemical examination of that substance might prove interesting.

M. de Cossigny brought two specimens of the juice of the papaw, one in a dry state, without any preparation, and the other in the form of a soft extract, from the milk of the papaw; which had been kept with an equal quantity of rum, and afterwards evaporated.

The first was of a lightish yellow colour, semi-transparent, had a slightly saccharine taste, no perceptible smell, a very firm consistence, and the form of small irregular lumps.

The second, on the contrary, was of a reddish brown colour, semi-transparent, and tasted like boiled beef.

Both of these specimens, when placed on ignited charcoal, decrepitated, bubbled, turned black, and exhaled a smell exactly like that of scorched meat. When the action of the fire is continued till perfect incineration takes place, there remain white ashes in small quantity, the nature of which will be described presently; these ashes, submitted to the flame of the blowpipe, were surrounded with an extremely phosphorescent light.

Chemical Experiments with the dry unprepared Sample.

This substance, which is dry and brittle when kept in a dry place, becomes soft and pliant if exposed to a humid atmosphere.

When brought in contact with 36 times its weight of water, it dissolved, and formed a milky liquor, which frothed when agitated like a soap lather. After some time, the liquor grew clear, by depositing a white matter which remained undissolved. But it soon became turbid again: a mucilaginous pellicle was formed on the surface; it exhaled a very fetid odor, which perfectly resembled that of animal matter in a state of putrefaction; it at length became clear a second time, and deposited white flakes, doubtless proceeding from the alteration it had experienced.

That portion of the juice of the papaw, which, as has just been stated, was not dissolved by the water, had a greasy appearance, grew soft in the air, and became viscous, brownish, and semi-transparent. This matter, placed on ignited charcoal, melted, and discharged from its surface some small drops of grease, and produced a crackling, like meat roasting before a very strong fire, accompanied with a smoke, which had the

the smell of volatilized grease: it left no perceptible residuum.

The solution in water of the juice of the papaw, mixed with nitric acid, formed a white precipitate so abundant that the mixture might be taken up in a solid mass.

Another portion of the same liquor, heated to ebullition, coagulated, and deposited a great number of white flakes. The liquor, separated by filtration, gave no precipitate with nitric acid; but the infusion of gall-nuts produced with it a very abundant precipitate.

A third portion of the solution of this juice mixed with alcohol was likewise precipitated, but not so abundantly as by nitric acid. Several metallic solutions, as those of lead, mercury, and silver, also precipitated the solution of papaw juice.

Alkalis, in a liquid state, dissolve a part of this juice; acids form a white precipitate with a solution of it, and at the moment of intermixture they give out a nauseous smell, exactly similar to that of animal matter treated in the same way. Alcohol highly purified does not perceptibly dissolve this substance. Yet when it is afterwards mixed with water it gives it somewhat of a milky appearance.

The dry juice of the papaw, when submitted to distillation, yielded much crystallized carbonate of ammoniac, a red, thick, and fetid oil, carbonic acid gas, carbonated hydrogen gas, and some carbon, which, after incineration, left white ashes, which were ascertained to be extremely pure phosphate of lime.

From the above experiments, it appears plain, that the dry juice of the papaw possesses all the properties belonging to animal substances, and particularly to the albumen of blood. In fact, the manner in which it

acts with acids, metallic solutions, alcohol, the infusion of gall-nuts, fire, &c. is perfectly similar to that of albumen.

I even suspect that it is nearly of the nature of blood, at least of the colouring part; for, I think, I perceived in the residuum of this matter, which was insoluble in water, the same characteristic as in animal fibre; but as it was mixed with a portion of grease, and there was but a small quantity of it, I could not ascertain that point in a sufficiently satisfactory manner.

On the soft Papaw Juice.

I mentioned at the beginning, that one of the kinds of papaw juice had been kept with rum, and afterwards evaporated in the form of a soft extract: I shall now describe the properties of that sample.

1. It has a reddish colour, is semi-transparent, and has a smell and taste very similar to animal juices; with this difference, that it is rather more insipid, and leaves a nauseous after-taste.

2. This substance grows soft in water, and dissolves almost entirely by agitation; the water by this combination acquires the property of frothing like gum-water; after some time a small quantity of white matter is deposited, which does not appear susceptible of uniting with water.

3. This solution is not instantly precipitated by nitric acid, but in twenty-four hours it forms a white deposit in considerable quantity.

4. Alkohol makes it turbid and white, like milk; afterwards abundance of small white flakes are separated from it.

5. The aqueous infusion of gall-nuts produces a precipitate exactly resembling that formed by a solution of glue.

6. A

6. A boiling heat does not make it turbid, as in the case of the dry papaw juice, but a considerable quantity of froth is formed by it.

7. Solutions of silver, lead, and mercury, form yellowish precipitates with the above solution.

8. The same solution when left to itself is soon covered with mould, but never becomes as fetid as that of the unprepared juice under the same circumstances.

9. The soft extract of papaw submitted to distillation in close vessels at first gave water, afterwards a reddish liquor, crystallized carbonate of ammoniac, a red, thick, and fetid oil, oily carbonated hydrogen gas, and, lastly, a light carbon, not easily burned, and which yielded by incineration very pure phosphate of lime.

In comparing the effects of these two samples of papaw juice, it appears that although they possess some properties in common, they have others which differ essentially: the soft extract has the taste of boiled meat, the other only a somewhat saccharine flavour; the latter is coagulated by heat, and the former is not. The soft extract undergoes scarcely any alteration with acids, the unprepared juice is congealed like the albumen of blood by the same re-agents.

It would therefore appear, that the sample kept in rum, and afterwards evaporated, had passed into the state of animal gelatine or glue; this alteration in my opinion is not surprising, for the albumen of blood experiences something similar if boiled in a great quantity of water, and this water be evaporated.

It will doubtless create a certain degree of interest to see a substance, produced by a vegetable, exhibit all the properties of animal substances, for I presume that this identity will not be called in question; we thence learn that nature has given to certain kinds of plants the faculty of forming similar compositions to those produced by

by the animal organization, which should in future render us cautious in pronouncing whether any matter belonged to the vegetable or animal system.

It will be remembered, that a long time since M. Fourcroy found traces of albumen in the juice of certain plants; that Scheele somewhere says that a substance of the nature of cheese exists in the leaves of vegetables; and that Proust has lately discovered the milk of almonds to be a combination of oil and cheese. But I know not that any one has yet had occasion to examine a vegetable entirely of an animal nature, and which wanted only the colouring principle to resemble blood; since it is found to contain, as has been explained above, a great quantity of albumen, a small portion of fibre, or at least some substance which has all the appearance of it, and, lastly, phosphate of lime in considerable quantity.

It were to be wished that chemists, who have occasion to visit countries where the papaw grows, would submit its milky juice, at the moment of its discharge, to chemical examination, and would likewise make some experiments on the tree itself, which must be of a particular nature. I am persuaded that they would obtain very interesting results.

Intelligence relating to Arts, Manufactures, &c.

Galvanic Society.

At the last meeting of this Society, M. Cossigny, and the senators Abrial and Aboville made a report on a preparation employed by the Indians to render the members of dead bodies flexible.

The reading of M. Winckler's extract relative to the Galvanic apparatus employed by Professor Schaub for deafness, was continued.

The

The President, M. Nauche, made some observations on the utility of employing epispastic remedies as well as Galvanism for that disorder; the latter then acts as a direct stimulant upon the organ of hearing, and produces a powerful effect.

Professor Aldini presented an account of his experiments in England on the bodies of criminals put to death by hanging, and of an experiment on a large scale, which he made on the sea-coast, by which he has proved that water, as in electricity, acts as a conductor of the Galvanic fluid to very great distances. He likewise repeated some experiments on the decomposition of water, according to the process of Wollaston.

Iron Manufactures.

The Iron-Office of Stockholm has offered, till the end of the present year, a gold medal, value 50 ducats, for the best answer to the following question: By what chemical or mechanical process, hitherto unknown in Sweden, can the manufacture of cast and wrought iron be improved in that kingdom, and by what means can the workmen be accustomed to it? These methods must be suited to the existing establishments for the manufacture of iron in Sweden.

Vaccine Inoculation.

Dr. Buttaz, known for his treatise on phosphorus, has been commissioned by the Emperor of Russia to travel through that empire for the purpose of extending the vaccine inoculation. He has presented him with a gratuity of 1,200 rubles, and a considerable sum for travelling expenses. After staying several weeks at Moscow, he proceeded to visit the principal towns in the south of Russia, with the intention of afterwards visiting the other governments of the empire.

List

List of Patents for Inventions, &c.

(Continued from Page 400.)

Barker Chifney, of London, Gentleman; for improvements in the manufacturing and preparing roofing slates, and in laying the same. Dated March 8, 1803.

James Bennet, of Oldham Street, Manchester, Lancashire, Manufacturer; for a method of felting woollen cloth, and also of felting cloth manufactured of sheep's wool, and other combined materials.
Dated March 10, 1803.

Samuel Miller, of the parish of St. Pancras, Middlesex, Engineer; for his improved method of applying the repelling or repulsive force of nature, in order to give a stronger impulse to any substance or body in motion, as well as to destroy the bad effects of its baneful activity. Dated March 16, 1803.

Edward Shorter, of New Crane, Wapping, Middlesex, Mechanic; for an apparatus for working of pumps. Dated March 21, 1803.

Robert Clark, of Fitzroy Place, Middlesex, Instrument Maker; for improvements in the construction of a truss, to be worn in the case of rupture.
Dated March 23, 1803.

Deers Egg, of the parish of St. Martin's in the Fields, Middlesex, Gun-maker; for improvements upon fire-arms. Dated March 23, 1803.

END OF THE SECOND VOLUME, SECOND SERIES.

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